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# THE TREATMENT OF OSTEOMYELITIS[1]

## OBSERVATIONS ON NINETY-SEVEN CONSECUTIVE CASES, WITH THE END-RESULTS

BY CHANNING C. SIMMONS, M.D., BOSTON

Surgeon to Out-Patients, Massachusetts General Hospital; Assistant in Surgery, Harvard Medical School

THIS report is based on the ninety-seven consecutive cases of osteomyelitis treated by me at the Massachusetts General Hospital up to October 1, 1913. During the year ending October 1, 1913, I had the opportunity of operating upon or treating forty-five cases embodying all types; for, as a special assignment, all cases of osteomyelitis entering the hospital were placed under my care. Before this I had had fifty-two cases turned over to me through the courtesy of the visiting surgeons who knew I was interested in the subject. These cases represent all types of the disease from the acute case to the chronic one of long duration that had been maltreated from the first. It also includes fifteen cases of specific or tubercular osteomyelitis or cases caused by direct extension of sepsis from the soft parts, as in septic hands or compound fracture. These I have called cases of "secondary osteomyelitis." Some of these cases were referred to the departments to which they belonged, while others were treated by me. Excluding these there are, therefore, eighty-two cases of idiopathic, infectious osteomyelitis.

I have attempted to better the results usually obtained in the treatment of osteomyelitis as the disease is seen in a large general hospital by recognizing and treating the acute cases promptly, while in the chronic cases I have tried to devise a method that will give some hope of a permanent cure in the various types. As a result of the work on this series I feel I can draw definite conclusions as to the prognosis of cases in a given class and also make suggestions which may be of value in the treatment of the more obstinate ones.

### TECHNIQUE

*Instruments.* No instruments other than those commonly used in bone surgery have been employed. For making trephine openings the Doyen burr has been used, but if the bone is eburnated it is liable to break. In these cases a trephine or chisel is to be preferred. I have used a motor driven saw recently but it generates an enormous amount of heat. In resections I have used a Gigli saw, and in the cases of bone graft the crest of the tibia was removed satisfactorily with a broad thin osteotome.

When possible all operations have been done with a tourniquet, as with it much more accurate work is possible. Care has been taken to do as little injury to the soft parts, periosteum, and living bone as possible. The wholesale curetting out of normal marrow, as is sometimes done, is to be deplored,

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as it is liable to spread the infection locally as well as to spread the general infection and destroy living bone. The wounds have usually been cleaned out with iodine or carbolic acid and alcohol, all septic tissues excised, and, when packed, iodoform gauze used. This can be left in longer without becoming foul than plain gauze and there is less likelihood of spreading infection at the first dressing. When Moorhof's bone wax was used in abscess cavities the cavity was sterilized and dried with alcohol and ether. It is necessary to get it absolutely dry or the wax will not stick to the bone, and as much care should be taken as a dentist uses to get the cavity in a tooth dry before introducing the filling. The wounds, when the wax was used, were closed without drainage.

In 1910 I reported cases of bone abscess treated in this manner and the cases are included in this series. From subsequent experience I see no reason to change the conclusions reached at that time — that the wax makes a good dressing but in my experience it is always eventually extruded as a foreign substance.

### MORTALITY

There have been three deaths in this series, two in acute cases and one in a subacute case. In one acute case (77) three of the long bones were involved when the patient entered the hospital. He died the fifth day after operation of staphylococcus septicæmia, septic parotitis, and multiple abscesses of the heart-wall and all the organs (autopsy). The other acute case (18) died on the eighth day of meningitis and septicæmia (autopsy). Culture from the original focus showed staphylococcus; from the blood, staphylococcus and influenza bacillus; and from the cord, influenza bacillus only. The third case (76) was originally classed as acute periosteal osteomyelitis. She had a large abscess of the thigh evidently originating in the femur. She died at the end of nine weeks, of general sepsis. At autopsy there was tuberculosis of the lungs, spleen, adrenals, and intestines, and a psoas abscess. In the light of these findings and the fact that only one of the several cultures taken at operation showed a growth, I am inclined to think that the process was tubercular from the first and have placed the case in the "secondary" group.

### GENERAL INFECTIONS

It is probable that in all cases the bacterium causing the disease is brought to the part in the blood-stream, so all cases should be regarded as general infections. In this paper the term is restricted to cases showing the involvement of many bones in a similar process, or where there were other foci of infection in the soft parts. Using this definition there were twenty cases, six acute and fourteen chronic, or 24 per cent that showed evidence of a general infection. In three of these, all chronic cases of less than a year's duration, the focus of infection was in the soft parts and the bones were involved secondarily (Cases 80, 88, 93). The foci were respectively a septic thumb, boils on the neck, and a carbuncle of the nose. The latter case had four bones involved as well as suffering from pneumonia, empyema, and a "psoas abscess."

Six acute cases had a general infection at entrance (Cases 15, 18, 68, 77, 85, 96). One of these had three bones affected when first seen and died on the fifth day of pyæmia (77), and one died on the eighth day of meningitis (18). The other four cases recovered, although desperately ill for a long time. One of these (Case 85) had eleven bones involved as well as pericarditis with effusion, pleurisy with effusion, and ascites with an enormously enlarged liver. The chest was tapped four times and the abdomen twice. The boy can hardly be called well yet, 15 months after the first operation, as a new focus developed in a metatarsal three months ago. The length of time a general infection may persist occasionally manifesting its presence by new foci appearing in previously healthy bones is remarkable. In Case 93 an acute focus appeared in the lower end of the radius 14 months after the first operation for osteomyelitis in the humerus. The process was acute, as shown by the appearance of the bone at operation, and not a flare-up of an old focus that had been overlooked.

Fourteen chronic cases gave a history of a

general infection or showed evidence of it in the multiple scars over the various bones. One of these had an acute infection from the flare-up of an old process in the head of the humerus (Case 81). There was panophthalmitis and multiple abscesses in the soft parts all over the body, but no other bones were infected.

### COMPLICATIONS

The complications were so many and varied that only certain ones will be mentioned. The wounds healed as granulating septic wounds do and occasionally required secondary operations for pocketing. In the cases of general infection, almost all possible complications occurred and it was manifestly impossible to foresee or guard against them. One chronic case was a bleeder and the hæmorrhage was stopped with considerable difficulty. This man spoke little English but said later that the same thing happened after a previous operation. One case (11), an adult with chronic bone abscess of the head of the tibia, had infection of the knee following operation, necessitating later resection of the joint. This patient walked around the ward the afternoon of the day of operation, which fact probably had some bearing on the subsequent infection of the joint. There have been several cases of erysipelas, usually around the sinus, developing several months after the patient has left the hospital. In one case it developed around the scar on the leg where there was no open wound. There were six of these cases, two of them having erysipelas twice (Cases 12, 49, 53, 67, 68, 82). Two other cases gave a history of erysipelas during the acute attack many years before (Cases 22, 57).

### ETIOLOGICAL DATA

The data in regard to age, sex, bones involved, etc., is similar to that given in other articles on the subject. In the table the cases in which more than one bone was involved are grouped according to the bone in which the process started. I think a much larger proportion of the cases is due to trauma than the table shows, as in many of the chronic cases the details of the onset are very vague.

| *Age* (at onset of disease): | Cases |
|---|---|
| 0 to 3 years | 1 |
| 1 to 3 years | 7 |
| 3 to 5 years | 9 |
| 5 to 10 years | 17 |
| 10 to 15 years | 23 |
| 15 to 20 years | 14 |
| 20 to 30 years | 6 |
| 30 to 40 years | 3 |
| Over 40 years | 1 |
| *Sex:* | |
| Males | 62 |
| Females | 20 |
| *Etiology:* | |
| Trauma | 37 |
| No trauma | 28 |
| Typhoid | 1 |
| Syphilis | 2 |
| Tuberculosis | 6 |
| Compound fracture | 2 |
| Direct extension sepsis | 4 |
| Metastatic from soft part sepsis | 3 |
| Erysipelas (?) | 2 |
| None given | 12 |

*Diagnosis* with which patient was admitted to the hospital. Most of these were acute cases and the diagnoses are given to illustrate the common errors.

| | Cases |
|---|---|
| Sprain | 11 |
| Abscess | 11 |
| Rheumatism | 6 |
| Meningitis | 1 |
| Scurvy | 1 |
| Typhoid | 1 |

BONES INVOLVED

| | | |
|---|---|---|
| Humerus: | | |
| Upper end | 8 | |
| Lower end | 2 | |
| Shaft (local) | 5 | |
| | — | 15 |
| Ulna: | | |
| Upper half | | 1 |
| Ilium | | 2 |
| Femur: | | |
| All shaft | 1 | |
| Upper end | 7 | |
| Lower end | 7 | |
| Shaft (local) | 7 | |
| | — | 22 |
| Tibia: | | |
| All shaft | 10 | |
| Upper end | 10 | |
| Lower end | 10 | |
| Shaft (local) | 4 | |
| | — | 34 |
| Fibula: | | |
| All shaft | 2 | |
| Upper end | 1 | |
| | — | 3 |
| Os calcis | | 2 |
| Metatarsal | | 2 |
| Jaw | | 1 |

| | |
|---|---|
| Several bones involved | 14 |
| "Secondary" | 15 |
| Diffuse osteomyelitis | 13 |
| Localized osteomyelitis | 69 |

### CLASSIFICATION

I have adopted the following classification as a matter of convenience. It is not made on any pathological basis but is of value in determining the treatment to be instituted in a given case. The classification may at first seem complicated but men who have had much experience with osteomyelitis will, I think, at once recognize the various groups. Certain cases fall naturally into groups, but a few do not, and these have been arbitrarily assigned to the groups where I think they belong.

| | Cases | Total |
|---|---|---|
| Acute | | 24 |
| Central | | |
| Diffuse | | |
| Fulminating | 0 | |
| Ordinary acute | 4 | |
| Local | | |
| With bone destruction | 4 | |
| Mild type (bone abscess) | 12 | |
| Periosteal | 4 | |
| Epiphysitis | 0 | |
| "Secondary" (tuberculosis, syphilis, etc.) | 0 | |
| Chronic | | 56 |
| Central | | |
| Diffuse | | |
| 6 to 10 weeks' duration, | 2 | |
| 3 to 12 months' duration, | 5 | |
| Many years' duration, | 10 | |
| Local (with bone destruction) | | |
| 6 to 10 weeks' duration | 0 | |
| 3 to 12 months' duration | 9 | |
| Many years' duration | 2 | |
| Local (bone abscess type) | | |
| To one year duration | 5 | |
| After one year | 17 | |
| "Resting" cases | 2 | |
| Periosteal | 3 | |
| Epiphysitis | 1 | |
| "Secondary" | | 15 |
| | | 95 |

The acute cases naturally group themselves into the central and periosteal types. The central is the common form and has been further divided into diffuse and local, depending on whether the entire shaft of a bone is diseased or only a portion of it. The local type has been again subdivided into two classes: those cases with bone destruction and the formation of a sequestrum, and those without bone destruction—the mild bone abscess cases seen in children. In many cases where bone destruction would undoubtedly occur it may be prevented by an early operation. The periosteal form is rare and relatively unimportant.

I have considered cases of roughly more than two weeks' duration as chronic. These chronic cases have been classified in the same manner as the acute: diffuse, always with bone destruction; local, with bone destruction; and local, without bone destruction (bone abscess). All the chronic cases have been again divided in relation to the duration of the disease, as the prognosis and treatment is different in the early cases than is used in those of many years' duration.

Epiphysitis is what the name implies, osteomyelitis occurring in the epiphysis.

Resting bone abscess is a term that has been applied by Thompson to the bone abscess in its quiescent stage when it is not causing symptoms. At this time it is usually filled with clear fluid.

I think it is the common impression, and the one usually given in textbooks, that osteomyelitis is a disease that destroys all or most of the shaft of a long bone and is always severe and accompanied by marked constitutional disturbance. In reality the reverse is true. The average case of osteomyelitis is comparatively mild but the difference is, I believe, only one of degree depending on the site, the severity of the infection, and the resistance of the individual. I believe a very mild infection may occur which, in children, might be called "rheumatism" or "growing pains" which may subside and the infectious material be entirely absorbed, never causing further trouble or requiring operation. In this series in but thirteen cases was the entire shaft of a long bone involved, while there were thirty-seven cases without bone destruction. These were the acute cases operated upon early, and the cases of chronic bone abscess, and represent about 45 per cent of the total number.

### ACUTE CASES

The acute cases comprise by far the most important group, as the prognosis of the disease, in a great measure, depends on its early recognition and its prompt energetic treatment. Some of the cases where there is extreme prostration and severe general infection are very difficult to treat at any time, but the numbers of these are compara-

tively small. The fulminating cases with toxæmia in which death occurs in one or two days are practically hopeless from the first, but these are rare although possibly one of this series might be considered fulminating (Case 77).

In every case of sprain or rheumatism in children the possibility of osteomyelitis should be remembered. Many of the mild cases have few local symptoms which might not be seen with a sprain. There is little or no swelling but marked tenderness over the end of the bone involved. If careful examination of the joint is made, motion is usually painless, which is important in ruling out rheumatism although the pain is usually referred to the joint. In the younger children inability to use a limb and fretfulness may be the only symptoms. These symptoms with a leucocytosis and some temperature make the diagnosis reasonably certain and operation should be advised. The X-ray is always negative. But little harm is done if the diagnosis is wrong, while on the other hand years of suffering may be saved by prompt treatment. Case 68 is an illustrative case of this type of osteomyelitis.

CASE 68. Male, 11 years old; had always been well. Three days ago he fell, twisting his left leg under him. Since then he has had severe pain in the leg and has been feverish; has not vomited, but is restless and cannot sleep. Examination: Well nourished boy; thorax and abdomen normal; throat, red; pulse, 130; temperature, 104°; leucocytosis, 20,000; left tibia seems possibly slightly thickened. It is very tender just above the ankle, and quite tender over the tibial tubercle. X-ray negative. Operation: Tourniquet. Incision over lower part of tibia. Periosteum slightly thickened. Two burr openings made and pus found in medulla. Same thing done at upper end of bone and while no pus found, the marrow was dark red. Culture from lower end of tibia showed profuse growth of staphylococcus aureus; from upper end, slight growth. Culture from throat showed streptococcus. Course: The temperature dropped and the pain was relieved shortly. On the sixth day the temperature again went up and a focus was found in the patella and operated upon. Culture showed staphylococcus. The recovery was uneventful, and the wounds healed in three months without the discharge of a sequestrum. The patient was well one year later (Fig. 14).

I have found pus or obtained a positive culture from the medulla in every early case I have operated upon.

The above applies to the early mild cases. The symptoms in the severe cases are similar, varying only in degree, but may be overshadowed by the toxæmia and evidence of general sepsis. Thus there may be symptoms similar to meningitis, typhoid, or milliary tuberculosis, and in cases presenting these symptoms the long bones should be examined to rule out the possibility of osteomyelitis. In the mildest infections the symptoms are as first stated only less marked and these have usually run five or six weeks before surgical aid is sought. In these the X-ray is of value in making the diagnosis.

*Periosteal.* The four cases I have placed in this group I infer are periosteal osteomyelitis or acute periostitis, as there was an abscess in the soft parts directly over an area of bone bare of periosteum. The medulla on opening was normal. I think it impossible, however, to rule out a septic hæmatoma, as the symptoms were those of an abscess in the soft parts following trauma. LeConte makes a point of the fact that the process may start anywhere in the cortex or medulla, and while this is undoubtedly true I consider for practical purposes in most cases the infection starts in the medulla or, much more rarely, under the periosteum.

The treatment in all these acute cases has been the same — immediate operation with retraction of the periosteum and the making of multiple openings in the medulla beginning near the epiphysis, with a burr or trephine, until normal appearing marrow is reached. Two or three openings are usually sufficient and the operation does not take more than fifteen or twenty minutes. When a flat bone as the ilium is affected, drainage is about all that can be done. Many cases seen early will heal without further trouble; but if necrosis does occur, subperiosteal resection should be done in from six to ten weeks, depending on the bone. If the cases are operated upon before bone destruction actually occurs and the pus is thus given a vent, the greater number will heal in a comparatively short time, without the formation of a sequestrum. In many of the cases classed as acute without bone destruction I believe necrosis would have taken place if the operation had not been done at the time it was. Of the eight cases recognized and treated

within a few days of the onset of symptoms, in only one (Case 58) did a sequestrum form. In certain of these, pus was found in the soft parts and under the periosteum as well as in the medulla, while in others no pus was found but the medulla was of a dark color. These latter cases gave a positive culture and the symptoms subsided after operation. I have done immediate subperiosteal resection in but one case and can draw no conclusions. This case was of six days' duration and the entire shaft of the tibia was destroyed. If practical it would be an ideal operation where the shaft of a long bone is destroyed early.

CHRONIC, WITH BONE DESTRUCTION, LESS THAN THREE MONTHS' DURATION

*Diffuse and local.* These are the cases suitable for the operation of subperiosteal resection. The acute process has quieted down, and the limb is swollen and presents multiple sinuses. The X-ray at this time shows a general worm-eaten appearance of the bone with a haziness under the periosteum representing the new-formed bone (Fig. 5). The operation has been done as described by Nichols and is really an early complete sequestrotomy. Care should be taken to remove all the shaft, or diseased bone, to obviate the possibility of secondary operations for pieces left, and, in fact, secondary operations for one thing or another in my experience are the rule. The operation is usually simple and easy where there are two bones, as in the lower leg or forearm, but it entails considerable shock. The incision is carried the entire length of the bone, the periosteum and new-formed involucrum attached to it stripped back, and the old shaft pulled out or divided through normal bone. I found it easier in one case to divide the bone in the center and remove it in two pieces.

There have been in this series six cases of subperiosteal resection. Two have not been included in any of the tables, as I did not know where to place them. In one (Case 33) the shaft of the tibia had been removed seven months before by Dr. Hugh Williams, but about one and one-half inches of dead bone had been left at the upper and lower extremity. These sequestra were removed and the wounds healed in a few months. The boy is perfectly well and using his leg twenty months later (Fig. 19). In the second (Case 51) the resident surgeon had done the operation six months before, but had removed only the center third of the tibia. I removed several sequestra and much involucrum from both ends of the bone. The wounds healed in about six months and the boy was well and has been using his leg one year later. These two cases illustrate the necessity of removing the entire shaft of a bone to the epiphyses, if it is all diseased, not being deterred by the near approach to the joint. In one (Case 85) the operation was done five days after the onset of the disease and the entire shaft of the tibia removed. While I think the operation saved the boy's life, regeneration was poor and it was necessary to do a bone-graft operation eleven months later after the wound was entirely healed. This has "taken," but the growth of the bone has been very slow. However, it is now solid at one end — three months after the operation. The other three cases were operated upon at the time of election; that is, eight to twelve weeks after the onset of the disease or after the dead bone had separated and before the involucrum had become too thick. One (Case 58) was an acute case which progressed, after the first operation of trephining and drainage, to bone destruction. The upper half of the tibia was resected and the bone re-formed with great rapidity, the child being able to walk on the leg in eight weeks. Unfortunately, two months later, while playing, he fell down a flight of stairs and broke his leg. Following this, although the fracture healed promptly, a sequestrum formed and it was five months before I could induce the family to bring him into the hospital for its removal. When last heard from he was well but still had a small granulating area over the head of the tibia (Figs. 1, 2, 3, 4). In Case 53 the entire shaft of the tibia was removed nine weeks after the onset of the disease; the bone regenerated well and the boy was using his leg in eight months. Two small secondary operations

were necessary. It is now twenty months since the operation. There is no shortening of the leg (Figs. 5, 6, 7, 8, 20). In Case 50 the entire shaft of the tibia was removed six weeks after the acute attack, at which time the shaft lay perfectly loose in the periosteal sheath. Regeneration was poor and ten months later it was necessary to do a bone graft. The graft "took" and the boy was walking on the leg four months later. There is three-fourths inch shortening. Why regeneration did not occur I do not know, as it seemed an ideal case (Figs. 9, 10, 11).

Thus of five cases in which subperiosteal resection was done at the time of election, regeneration took place satisfactorily in four, while in one case a subsequent bone-graft was necessary. The sixth case was done five days after the onset of the disease and did not regenerate. This may have been due in part to the severity of the general infection. One thing is striking in the X-rays of these cases. In those that were successful, bone formed at the same time along the entire length of the periosteal tube (see Fig. 7), while in the unsuccessful cases this did not occur but the bone grew in from the epiphyseal ends (Fig. 9). I am not prepared to state whether bone is formed from the periosteum or whether it acts only as a limiting membrane. After subperiosteal resection the periosteum appeared to play no part in the two that were unsuccessful but the bone grew in from what was left at the epiphyses until it nearly met in the center. I have also no opinion as to whether a graft lives or is merely osteoconductive. From the X-rays of Case 50 I should say that the new bone was formed around the graft probably from the bone-cells in it but the graft itself did not grow, as the X-ray taken four months after operation shows the graft in its original size and shape through the new thick tibia.

*Bone-grafts.* In the two cases in which regeneration was imperfect after subperiosteal resection I performed a bone graft, using the crest of the opposite tibia to fill in the defect. The graft in each case was about five inches long and the size of a large lead pencil. These were removed with ease with a broad thin osteotome. The attempt was first made to cut them with a motor driven saw, but I resorted to the simpler method, as the saw generated so much heat I feared the life of the graft would be endangered. In one case (Case 50) the graft was taken without the periosteum, while in the other (Case 85) the periosteum was left attached to the graft. The grafts were placed in a trough in the soft parts, previously prepared, thus bridging the defect, and were fastened to the ends of the bone with catgut in a rough mortise-and-tenon joint. In both cases a small sinus formed but did not interfere with the life of the graft. In Case 50 regeneration was rapid (Figs. 9, 10, 11) while in Case 85 it has been slow, but at the present time the leg is stiff and the graft is slowly increasing in size (Figs. 17, 18).

### CHRONIC, WITH BONE DESTRUCTION, THREE TO TWELVE MONTHS' DURATION

*Local and diffuse.* The time limit set on these cases is purely arbitrary and depends on the bone involved and many other conditions. I have placed in this class cases in which too much involucrum has formed to permit of performing resection but in which the sequestrum is loose. Simple removal of the sequestrum with packing of the cavity usually leads to a permanent cure (Fig. 15).

### CHRONIC, WITHOUT BONE DESTRUCTION, LESS THAN ONE YEAR'S DURATION

*Bone abscess.* This may be said to be the subacute stage of acute localized osteomyelitis of the mildest type. The abscess has usually broken when first seen and a sinus is present. The diagnosis is made on the history and X-ray which shows a definite abscess cavity in the bone. Certain of these cases cause symptoms of greater or less severity for months before the abscess breaks or the diagnosis is made. It makes little difference what operation is done, all heal satisfactorily. Bone-wax may be used to make the dressings easier or the cavity may be packed with gauze. The following case is a typical example of this class.

CASE 81. Female, 5 years. Tonsils and adenoids removed when three years old. Convulsions three or four

times a year, preceded by pain in the lower abdomen. For two months left ankle has been swollen and painful and child cannot walk on it; some tenderness; pain never severe but worse at night; no history of trauma. Examination: Well developed and nourished child. The lower end of the left tibia is somewhat thicker than the right and is slightly tender on pressure; motions of ankle, perfect; no sinus; otherwise symptoms negative. X-ray shows a definite abscess cavity in the lower end of the tibia and a question of another small one in the epiphysis. Operation: Tourniquet. Two-inch incision over lower end of tibia. Cortex removed and cavity containing thick yellow pus opened. Cleansed with carbolic acid, alcohol, and ether, and filled with bone-wax. Epiphysis explored but nothing found. Wound closed in layers; no drainage. The wound remained clean at first but one week later a sinus formed which discharged wax. Wound healed four months later. Well one year after operation. X-ray taken. Culture, staphylococcus aureus.

The cases in the foregoing groups, that is, the acute cases and the chronic cases of less than one year's duration, if properly treated and followed up, should with few exceptions be cured. These represent 55 per cent of this series, or forty-four cases. There will always be some failures. The exceptions are the severe cases with the involvement of many bones, and the cases in which the process starts in such bones as the pelvis or spine. If one operation does not cure, a second should be done before it is too late, as after a year the bone apparently loses its power to proliferate and close the cavity or defect made by the disease. Cases requiring two or more operations, if done within a year, and finally cured should not in this disease be regarded as failures.

### CHRONIC, WITH BONE DESTRUCTION, SEVERAL YEARS' DURATION

*Diffuse and local.* These are the most difficult cases and are often hopeless. They are generally adults who had the disease in childhood, the diagnosis being overlooked or the case badly treated. Whether in future years as the disease is recognized and better understood there will be fewer of these cases remains to be seen, but probably not in this locality so long as the immigration of the lower classes of Europeans continues. A few cases were probably hopeless from the beginning.

These cases are usually adults and give a history of an acute attack when a child which incapacitated them for six months to three years. Following that, abscesses have broken out at intervals of from six months to five or ten years, with or without the discharge of a piece of bone. The history of one of these cases is typical of the rest.

CASE 45. Male, 42 years. Sprained ankle in 1874 following which he had a bone abscess, laying him up for five months. An operation was performed in 1888 at this hospital for another abscess. In 1897 he was in the City Hospital for some time and an extensive operation was done. Following this he was well two years but entered this hospital again in 1899 for the same thing. He was in bed three weeks. In 1900 another abscess formed following trauma and he was in the hospital two weeks. After this he was well two years but then hit his leg and another abscess formed. He was in the hospital this time two weeks. Abscesses formed again in 1908 and 1912 following trauma, and required operation. He was in the hospital about a week at each time. In the summer of 1912 he was in the Beverley Hospital twice for abscess, and in December, 1912, he reëntered this hospital and demanded amputation. Thus he was in a hospital eleven times and the leg was finally amputated. If it had been properly treated at first I think this would all have been obviated.

The bone, although living in most of these cases, has a very low vitality and becomes necrotic with the slightest trauma. In the X-ray the bone is much thickened and shows numerous cavities throughout its entire length while the skin is thin and shiny, ulcerating at the slightest trauma. These are almost hopeless cases to treat and I know of no method to cure them except subperiosteal resection with transplantation of the fibula or crest of the other tibia. The few cases I have suggested this to have always refused when told of the length of time it will incapacitate them and the possibility of failure. In many, although the entire shaft of a long bone has been destroyed, the sequestrum of at least one-half has been thrown off early through the efforts of nature and this portion of the bone is comparatively normal. Even if this has not occurred, usually only one portion of the bone is badly diseased and with the exception of the cases in which the leg was amputated that was the condition found. At any time some quiescent focus in another part of the same bone may light up, however, but this can be treated later.

In some of these cases where there were multiple abscess cavities surrounded by eburnated bone, the cavities were opened and cleaned, and the sides cut away leaving a comparatively flat surface instead of a hole

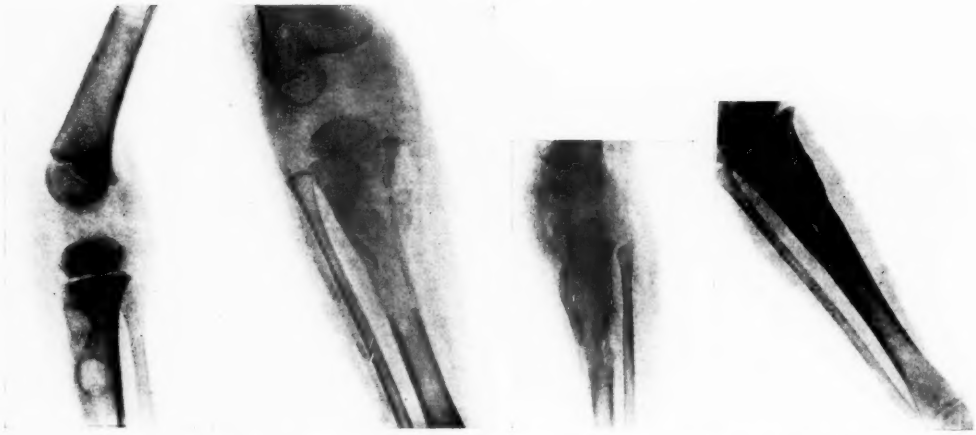
TABLE OF CASES WITH RESULTS AT THE END OF ONE OR MORE YEARS

| | Total Number of Cases | Not Traced | Died | "Cures" | Failures | Under Treatment | Secondary Operations Necessary | Remarks |
|---|---|---|---|---|---|---|---|---|
| Acute diffuse | 4 | | 1 | 1 | | 2 | 3 | Cure should be called success as still a sinus. |
| Acute local with bone destruction | 4 | | 1 | 3 | | | 3 | |
| Mild local without bone destruction | 12 | 1 | | 10 | 1 | | 1 | The failure is now under treatment |
| Acute periosteal | 4 | 2 | | 2 | | | | |
| Chronic bone destruction | | | | | | | | |
| Up to 2 months | 2 | | | 2 | | | 2 | |
| Up to 1 year | 14 | 2 | | 12 | | | 3 | |
| After 1 year | 12 | 1 | | 5 | 3 | | 3 | One case palliative operation. One case not operated upon. One case of amputation. |
| Chronic bone abscess | | | | | | | | |
| Up to 1 year | 5 | | | 5 | | | | |
| After 1 year | 17 | 5 | | 6 | 6 | | 3 | Three operations on one case classed as failure who is now well. |
| "Resting" cases | 2 | | | 2 | | | | |
| Chronic periosteal | 3 | | | 2 | 1 | | | |
| Chronic epiphysitis | 1 | | | 1 | | | | |
| Secondary (tuberculosis, syphilis, etc.) | 15 | | 1 | | | | | |
| Total cases (excluding secondary) | 80 | 11 | 2 | 51 | 10 | 2 | 18 | |

or trough. About half the thickness of the bone was removed in this manner. The denuded bone or cavity was then covered by a flap of living tissue, either a flap of skin preferably, or one of fat and fibrous tissue. This method seems to me to give the best chance for cure, but is not by any means applicable to all cases (Fig. 16). I do not think that opening the abscess and packing the cavity ever leads to permanent cure, but when bones such as the femur are involved it is often all that can be done. If the patient is intelligent, understands the condition, and will consult a surgeon when the pain begins, it is not a bad palliative operation as the wounds often heal promptly and relief may be experienced for several years.

CASE 50. Male, 31 years. Oteomyelitis when 14 years old which was treated for some time as a sprained hip. Abscess opened one year later. One year later a piece of bone came out. Three years later broke open but healed in a short time. Another abscess formed five years later. Three years ago and one year ago had attacks of rheumatism in that hip which quieted down after a few months. At present the hip has been sore for three months and he can hardly walk. Examination: Scar behind left trochanter; some tenderness. X-ray shows much thickening of upper end and neck of femur and two abscess cavities situated near neck. Operation: Cavities opened after cutting through one and one-half inches of eburnated bone. Sides of cavity cut away as much as possible. Skin-flap made and swung into cavity but this was not very satisfactory as cavity was too deep. Culture, sterile. Wound healed in six weeks. Seven months later pain recurred and a superficial abscess was opened. This did not necessitate giving up his work and healed in ten days. A second abscess formed three months later which also healed promptly after opening. He has now gone without symptoms fourteen months. I do not consider this case a cure but I know of no way of effecting one. The patient is intelligent and if he consults a surgeon as soon as the pain begins I think he will get along with very little trouble.

*Bone abscess*, more than one year duration (Brodie's abscess). These cases represent the chronic form of the mild local infection. The history is usually typical. The early history is that of an acute abscess which usually breaks, and the sinus, after discharging for a time, heals. After this, at intervals of six months to twenty years, the pain in the "joint" recurs and either subsides or another abscess breaks with the relief of symptoms. This may happen many times during a patient's life, the exacerbations usually being brought on by trauma. Some of the milder types of abscess never break, the pain lasting



Case 58. Figs. (from left to right) 1, 2, 3, 4. Subperiosteal resection upper third of tibia.

Fig. 1. Shows condition about two weeks after onset of acute attack and after the first operation of trephining. The trephine openings are seen. There is no bone destruction to be made out but the plate shows marked periostitis.

Fig. 2. The upper third of the tibia became necrotic and it was necessary to do a subperiosteal resection. This plate was taken about three weeks after the operation and twelve from the onset of the disease. Bone is already forming in the periosteal tube.

Fig. 3. About seven weeks after operation. New bone has formed bridging the defect, and the leg is stiff, but not strong enough to bear weight.

Fig. 4. About four months after operation. The bone has re-formed and is normal in size and shape. There is undue thickening of the cortex as yet and a defect can be seen at the center.

for a time, then subsiding. Thompson gives a very good descripton of these abscesses. Most of my cases were reported in the *Boston Medical and Surgical Journal*, May, 1913, in an article on "Localized Osteomyelitis of the Long Bones." The X-ray is typical. There is thickening of the cortical bone which may be so great as to mask the abscess-cavity in the center. In most cases the cavity shows clearly. The abscesses vary in size, some of them being as large as three inches in diameter (Figs. 12, 13).

Case 2. Male, 33 years. Twenty years ago kicked by a horse just below the right knee. The place became red and painful and two months later an abscess broke which discharged for two months and then healed. Four years later it broke again but healed in a few months. He was then perfectly well for fifteen years, or until a year ago, when the abscess broke again. It soon healed but recurred two months ago. Examination: A red, tender area three inches in diameter over the head of the left tibia; the bone is thickened. X-ray shows periostitis and cavity in head of tibia. Operation: Cavity opened, cleansed, filled with bone-wax, and closed without drainage. Culture, staphylococcus. The wound remained clean but wax began to ooze from between the stitches in about a week. The wound continued to discharge for four months. A year later he was well and an X-ray showed the cavity obliterated.

I believe the best treatment when possible is to transform the cavity into a flat or slightly curved surface even if half the thickness of the bone has to be removed, and to cover the surface with a flap of living tissue, either a pedunculated skin-flap or a flap of muscle. Bone-wax may be used but in my experience it has always been extruded as a foreign body. Others have, from their reports, had perfect success with it but although I think I have used moderate care I cannot repeat the work. Opening and packing these cavities is apparently useless, for although it is a perfectly satisfactory operation in the cases of less than one year's duration, in these later ones the bone has not the power to grow in and fill the defect. The wound may heal but I believe an X-ray would show the abscess as before and that the patient will eventually have more trouble. Sterilizing the cavity, allowing it to fill with blood-clot, and closing the wound without drainage, may give a very satisfactory immediate result, but I doubt if new bone fills the cavity although it has been shown that fibrin stimulates the growth of bone.

I have called cases in this group "cures" that have gone without symptoms for more

Case 53. Figs. (from left to right) 5, 6, 7, 8. Subperiosteal resection of tibia.

Fig. 5. Before operation, eight weeks after onset of acute attack. Entire shaft destroyed and in X-ray the bone has worm-eaten appearance. New bone seen beneath periosteum.

Fig. 6. Two weeks after subperiosteal resection. The posterior wire splint and the fibula alone can be seen.

Fig. 7. Eight weeks after operation. The new-formed bone is seen in the periosteal tube and growing in from the epiphyses.

Fig. 8. Ten months after subperiosteal resection. The bone has re-formed but is still somewhat small and does not appear normal. It is strong, and functionally at this time the result is perfect. (See also Fig. 20.)

than one year from the time of discharge from the hospital. I hesitate to do this, as, knowing the course of these abscesses, I do not think they should be called true cures until an X-ray has been taken which shows the cavity obliterated (see Case 28).

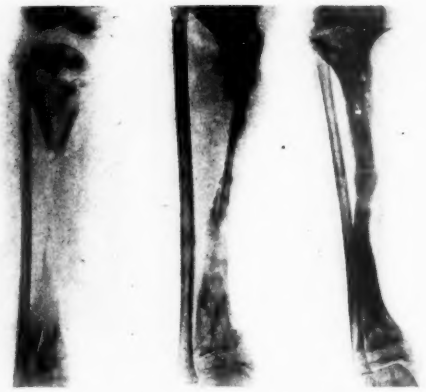
*Chronic periosteal.* In these cases there is usually a sinus leading to a small piece of necrotic bone on the outer side of the cortex. Excision of the sinus and scar tissue with removal of the necrotic bone and sterilization of the cavity with iodine or carbolic acid usually effects a cure. In some cases the wound may be closed without drainage.

*Epiphysitis.* My experience is too limited to draw any conclusions. I should say, however, that the area is so small that curetting and packing is sufficient to effect a cure.

DETAILED ANALYSIS OF CASES AND RESULTS

*Acute diffuse.* No case of more than a week's duration has been included. There were four cases in this group (Cases 15, 77, 85, 96). All had a general infection with the involvement of many bones and the problem was more to save life than to cure the local condition. Two of these were cases of osteomyelitis of the ilium. One has had several sequestra removed since as well as having had an operation on the humerus for bone abscess, all done in another city. At present, four years later, he has a small sinus, which opens at times, and he walks with a slight limp but is very lucky to be alive. In the other case eight weeks after the operation I removed a large part of the ilium subperiosteally. The bone has regenerated but the hip-joint is involved and two other operations have been necessary. The outlook for cure is poor. The fibula was also affected.

The other two cases originated in the tibia. One of seven days' duration had three bones involved at entrance and died on the fifth day of septicæmia (Case 77). The other case, of six days' duration (Case 85), also had three bones involved at entrance. In this case I did as LeConte has suggested—removed the whole shaft of the tibia at once. I think this undoubtedly saved the boy's life but regeneration was slow and bone was grafted later. This has "taken," but has grown slowly. The mother frankly says she wishes the boy had died and will not coöperate. Culture from all four cases showed staphylococcus.



Case 50. Figs. (from left to right) 9, 10, 11. Bone graft of tibia.

Fig. 9. X-ray of leg eight months after subperiosteal resection of the tibia. There is but little attempt at regeneration of the bone and the radiographs showed but slight changes in the preceding five months. What new formation of bone there is appears to have come directly from the epiphyses.

Fig. 10. X-ray two weeks after bone graft from the crest of the other tibia had been set in the defect. The graft was about five inches long and bare of periosteum.

Fig. 11. Four months after operation. The bone has entirely re-formed and while not yet straight is solid and the patient can bear the body weight on it. Evidence of a spontaneous fracture can be seen at the center of the bone. This is not an uncommon occurrence following subperiosteal resection and has no significance. A shadow nearly the size and shape of the graft can be faintly seen in the center of the bone. (I have been unable to get further X-rays of this case.)

*Acute local bone destruction.* There were four cases (18, 58, 61, and 67). Three had been treated outside the hospital and were sent in for abscess. The process was in the center of the shaft of the humerus (Case 61), the shaft of the femur (Case 67), the os calcis (Case 18), and the upper end of the tibia (Case 58). All four were very sick. Simple drainage of the medulla was done and discharge Cases 61 and 67 were told to report, the idea being to do a partial subperiosteal resection at the proper time, but subsequently they could not be induced to submit to furthur operation. One was seen many months later for erysipelas, and I was able to remove several sequestra while he was in the ward. He is now well, nineteen months after the first operation. The other case reports he is well twenty months after operation. Case 18 died on the eighth day of meningitis. The disease was of the os calcis of two weeks' duration and unrecognized. Case 58 was an acute case operated upon six days after the onset of symptoms. Bone destruction occurred and it was necessary to do a subperiosteal resection ten weeks after the first operation. This case is now well. Thus, of four cases in this group, one died of general infection while three may be called cures, although all required secondary operations.

*Acute local, without bone destruction.* This is the most important group and while in some cases the condition would probably have remained local and gone on to the formation of a bone abscess, in others it seems probable that if operation had not been done at once some of the bone would have been destroyed with the formation of a sequestrum. There are twelve cases in this group. Seven were operated upon within two weeks of the onset of symptoms and several of these within three days (Cases 40, 41, 44, 48, 63, 68, and 91). The other five were mild local infections and were operated upon two to four weeks after the onset (Cases 8, 10, 20, 52, 70). Cultures were as follows: Staphylococcus, 6; streptococcus, 1; bacillus, 1; pneumococcus, 1; sterile, 1; "dried up," 2. With one exception the cases were all children, the average age of the twelve being 10.7 years. Eight were males and four females. Trauma was mentioned as the cause in six, while in the other six no etiological factor could be determined. Operation consisted in making one or two trephine openings in the medulla, the number being governed by its appearance.

The end-results of these cases justify the stress I have laid on an early diagnosis and immediate operation. In eleven the end-result is known. Ten have had no further trouble (91 per cent), and in a few I have been able to get X-rays. The failure (Case 70) was a bone abscess of the lower end of the femur of four weeks' duration. At operation there was a large abscess in the soft parts about the bone, but, on trephining, the medulla appeared normal. The X-ray was negative. X-rays taken two months later showed a bone abscess about three-fourths inch from the trephine openings. The patient was urged

Fig. 12 (at left). Case 57, male, 19 years old. Acute attack when four. An acute recurrence of an old bone abscess which had been quiescent 15 years; cavity plainly seen; some periostitis; cortex not much thickened.

Fig. 13. Case 30. Bone abscess at upper end of humerus of many years' duration. There is so much cortical thickening due to the inflammatory process the cavity can hardly be seen. At operation the abscess contained at least two ounces of thick, yellow pus.

Fig. 14. Case 68. Acute osteomyelitis of tibia and patella. The X-ray was taken ten days after the operation of trephining the tibia and thirteen days from the onset of the disease. No bone changes can be seen in the tibia, although the medullary cavity contained pus. The upper part of the patella shows slight erosion. Healing took place without bone destruction.

Fig. 15. Case 75. Osteomyelitis of tibia five months after the onset of the disease. X-ray shows the sequestrated upper half of the bone surrounded by a large amount of involucrum. It is impossible to perform subperiosteal resection in these cases. Removal of the sequestrum resulted in a cure.

to have another operation at the end of six months but only submitted to it one year later, and is still under treatment.

*Acute periosteal.* I have placed four cases in this class (Cases 47, 69, 86, and 95). In three of these, following trauma, and in the fourth, following la grippe, pain developed which was referred to a joint and was followed by an abscess. At operation an abscess was found in the soft parts close to the bone which was bare of periosteum. In three cases the medulla was trephined but appeared normal. These cases might be septic hæmatomata but as no blood-clot was seen and as the bone was bare of periosteum I believe they originated in the bone or periosteum. Culture showed streptococcus in three cases and staphylococcus in one. The site was the lower end of the femur in three, and the center of the humerus in one case. But two of the cases have been traced and both of these are well.

*Chronic cases, with bone destruction, less than three months.* There are only two cases in this group, in both of which the entire shaft of the tibia was destroyed (Cases 50 and 53). The operation of subperiosteal resection was performed. One regenerated well and the boy was walking on the leg in ten months. The other regenerated poorly and it was necessary to do a bone graft from the shaft of the other tibia ten months after the resection. The graft was successful and the child was walking four months later. There was about one-half inch shortening.

*Chronic, with bone destruction, three to twelve months.* Fourteen cases: diffuse, five (Cases, 12, 26, 29, 39, and 88); local, nine (Cases, 34, 35, 36, 42, 75, 80, 87, 93, and 97). In these cases the sequestrum had formed and the involucrum about it was thick, in many cases three-fourths inch. They were treated by removal of the sequestrum and some of the involucrum with packing of the cavity. In some of the diffuse cases, as in Case 12, with destruction of the entire shaft of the femur, all the sequestrum could not be removed at once, the child being in too poor condition to stand the operation, and several

Fig. 16. Case 60. Osteomyelitis of the lower third of the tibia of many years' duration one year after operation. At operation the abscess-cavities were opened, about two-thirds of the thickness of the bone removed, and a flap of skin swung over the defect. No trouble since. The plate shows the amount of bone removed.

operations were necessary. The end-result is known in twelve of the fourteen cases. They have all been well for over a year.

*Chronic, with bone destruction, after many years.* Diffuse, ten (Cases 1, 22, 45, 46, 55, 60, 62, 72, 73, and 79); local, two (Cases 49 and 59). They were all middle-aged or elderly people and were of many years' duration. Average age, 40.5 years. Average duration, 28.5 years. Eleven were males, one was a female.

One case demanded amputation (Case 79). One case had erysipelas when first seen. He was also a "cardiorenal" and was such a poor surgical risk no operation was advised. When seen one year later he was comfortable and had been working steadily but had a small discharging sinus. In a third case (Case 72), an old decrepit man, the operation was simply palliative. He was well fourteen months later. The end-result is known in eight of the remaining nine, and five may be classed as cures, three as failures. In five cases the abscess was opened, the diseased portion of the bone removed with enough sound bone to transform the trough thus made in a flat area (Cases 46, 55, 59, 60, and 73). A flap of living tissue, either fat and fibrous tissue or skin, was then swung across the bone surface. Three of these are well over one year from the date of operation (Cases 55, 60, and 73). One (Case 59), has had two abscesses operated upon since and the process evidently is not cured. In the fifth (Case 46) the upper end of the tibia, the site of operation, is well but he has lately had an abscess of the lower end on which a similar operation has been done. He is not classed as a cure. In one case bone-wax was used (Case 22), the man reporting at the end of a year that he was well. In Case 1 the abscess was opened and packed. He has not been traced. In Case 45 a palliative operation was performed but the patient returned eight months later with the condition as bad as before, and demanded amputation.

*Localized, without bone destruction (bone abscess).* Less than one year's duration. There were five cases (Cases 4, 16, 24, 32, and 81). These represent the cases of low grade infection that have been overlooked. Four followed trauma and were sent to the hospital for sprains or rheumatism, and the fifth was diagnosed as a boil. Culture, staphylococcus in three, no growth in two. Bone-wax was used in four cases while the fifth was packed with gauze. In no case in which the wax was used did it stay in the cavity but a sinus formed and it was slowly extruded. All five cases are well over one year after operation and X-rays have been obtained of a few of them. The wounds healed slowly, the sinuses closing in from four to six months.

*Bone abscess, several years' duration.* There were seventeen cases (Cases 2, 5, 6, 7, 11, 14, 17, 21, 25, 28, 30, 57, 71, 74, 84, 90, and 92). Of these, twelve have been traced and the end-result is known. Six are well (Cases 2, 5, 7, 25, 57, and 90). In three bone-wax was used, two were packed, and in one the cavity was obliterated by turning in a flap of muscle. The six failures were as follows: In one bone-wax was used (Case 17) but at the end of a year a sinus persisted and the cavity was as large as ever (X-ray). Another operation was suggested but refused. In Case 28 the cavity was sterilized and allowed to fill with blood-clot. Healing was by first intention but eleven months later the symptoms returned and an X-ray

showed the cavity as before. Two more operations have since been performed on this case and the patient is now well, fourteen months after the last operation. The wound has been healed ten months. In Case 11 infection of the knee-joint followed the operation, necessitating resection. One year later he was well of his osteomyelitis but had a stiff knee. In Case 6, a bleeder, the cavity was packed. Three years later the sinus persisted and an X-ray showed the cavity as before the operation. In Case 30 a sinus persisted one year after operation. No X-ray was taken and there is no further report. In Case 92 the patient had a very large abscess of the head of the tibia. The cavity was obliterated by a pedunculated skin-flap. A sinus persists but he is still under treatment and it will probably heal.

*Bone abscess* ("*resting cases*"). There were two cases in this group. Both were in the center of the tibia, of long duration, and while they had caused symptoms had never broken as an abscess (Cases 13 and 38). The cavities, which were filled with clear fluid, were opened, sterilized, allowed to fill with blood-clot, and the wound closed without drainage. Healing was practically by first intention. Both patients were well over one year from the date of operation. The Wassermann in one case was negative and in the other it was not done.

*Chronic periosteal.* There have been only three cases in this group (Cases 19, 37, and 78). All were of the upper end of the femur. Case 19 followed typhoid fifteen years before, and had been operated upon eight times before. Considerable dead bone was removed at operation but further operation was considered probable. One year later two pieces of dead bone were discharged, after which the sinus healed and the patient has been well for three years. Case 37 had a flaking off of the cortex of the outer surface of the trochanter. The sequestrum was removed. He was well a year and one-half after operation. Case 78 writes that he still has a sinus and should submit to further examination and treatment.

*Chronic epiphysitis.* One case of five months' duration (Case 23). This was of the epiphysis of the os calcis. The necrotic area was curetted and the wound packed. The sinus closed in three months and the boy was well two years later.

Case 85. Figs. 17 and 18. Bone graft of tibia. Subperiosteal resection of the tibia was performed five days after the onset of the acute attack, at which time the shaft was entirely stripped of periosteum. Regeneration did not take place, but considerable bone has grown in from the epiphyses. There is a separation of the epiphysis of the fibula with dislocation upwards. Eleven bones were involved and the patient suffered as well from ascites, pleurisy, and pericarditis.

Fig. 17 (at left). Condition of tibia one year after operation of subperiosteal resection.

Fig. 18. Eight weeks after the bone graft from the crest of the other tibia was inserted. There is some new formation of bone about the graft. Clinically the bone is living, the graft has increased in size, and union is apparently solid at one end.

*Secondary cases.* The etiology in these was as follows:

| | |
|---|---|
| Tuberculosis (Cases 31, 56, 65, 76, 83, 89, and 94) | 7 |
| Compound fracture (Cases 3 and 82) | 2 |
| Extension of sepsis (Cases 9, 27, 43, and 64) | 4 |
| Syphilis (Cases 54 and 66) | 2 |

## SUMMARY

It is very difficult to draw conclusions from this series of cases definite enough to publish, although in my own mind the subject is fairly clear. I shall, therefore, give my impressions based on these cases and borne out by facts as far as possible. It is also manifestly unfair to compare the results of the treatment of osteomyelitis in a children's hospital where all the cases are

Fig. 19 (at left). Case 33. Result two years after operation of subperiosteal resection. There is no shortening and the function is perfect.

Fig. 20. Case 53. Photograph of leg ten months after subperiosteal resection. (See Figs. 5, 6, 7, 8.)

acute or of short duration with those in a general hospital where many of the cases are of twenty or thirty years' duration.

Certain of my cases I regard as cures while others I have little hope for, although they have remained well for over a year after operation. In general I believe a case of osteomyelitis seen and properly treated inside of a year from the onset of the disease should be cured. There are many exceptions to this statement and the prognosis varies as to the bone involved and the severity of the general infection. I consider Case 15 (acute diffuse osteomyelitis of the entire ilium with general infection) a successful case, although at the present time, four years after operation, he still has a sinus and walks with a slight limp. He is not, however, classed as a cure. It is also much easier to treat a diffuse case involving the entire tibia than one involving the femur, as, in the former, resection can be done and the bone is much more accessible. I tried once (Case 12) to do a subperiosteal resection of the shaft of the femur but had to give it up, as the child was in poor condition and nearly died on the table from loss of blood and shock. This child had intelligent parents and was followed up. She is now perfectly well and has been for two years but it was necessary to operate on her five times over a period of one and one-half years.

I do not consider a case of this disease a failure if the first operation does not cure as I would in other conditions but I think that at the first operation a prognosis as to further operations can be given with some degree of accuracy. The point is to do these secondary operations at the proper time with a definite object in view, and I cannot emphasize too strongly the importance of following the cases up during the first year.

In seventy-two of the eighty-two cases the age at onset was under 20 and in fifty-eight, or 70.8 per cent, under 15. To give up one or two years of a child s life to bring about a recovery from a serious disease is nothing if we know that he will be cured and will not have to spend a month every other year or two of his adult life in a hospital or at least be incapacitated and unable to work and support his family. I have cited one or two typical histories of these overlooked and improperly treated cases previously.

To sum up, if the diagnosis is made at the onset of the disease and the bone operated upon at once, the prognosis is good except in the most severe cases of staphylococcic septicæmia. This septicæmia can evidently exist in what may be termed a latent state for a long time.

## CONCLUSIONS

1. In children with pain in a limb and evidence of toxæmia, always consider osteomyelitis.

2. Operate early even if the symptoms are rather vague. If the diagnosis is incorrect practically no harm is done while if correct a great deal of suffering may be avoided.

3. In acute cases, open to the medulla and pack the wound. Prognosis good. The treatment and prognosis varies of necessity somewhat in these early cases but in general the earlier the operation the better the prognosis.

4. In cases where bone destruction has taken place, seen less than three months after the onset of the disease, perform subperiosteal resection when possible. Prognosis good.

5. In chronic cases of bone abscess of less than one year's duration, drain and pack. Prognosis good.

6. In chronic cases with bone destruction of less than one year's duration, remove sequestrum and pack. Prognosis good.

7. In old chronic cases, either with bone destruction or of the bone-abscess type, remove necrotic areas and drain. Try to obliterate the cavity with flaps of living tissue. If this cannot be done either use bone-wax, pack, or sterilize the cavity, allow it to fill with blood-clot, and close without drainage. The prognosis, if the cavity can be obliterated, is fair, otherwise poor.

8. The treatment when such bones as the pelvis are involved is unsatisfactory and the prognosis problematical.

9. When in old chronic cases the whole shaft of a long bone is badly diseased the possibility of resection of the entire shaft with bone transplantation should be considered before amputation is resorted to.

ACUTE DIFFUSE CASES

CASE 15. Male, 13 years, December 28, 1909. One month ago fell from bicycle, injuring left hip. Fell again, injuring same hip one week ago. Since then patient has been sick in bed with severe pain and high fever. Examination: The left hip is held rigid. Just below the crest of the ilium is a tender, red, fluctuating area. Temperature 103°; pulse 100; leucocytosis, 17,000; X-ray, negative. Operation: Three-inch incision over crest of ilium. Abscess opened and bone found bare of periosteum. Culture, staphylococcus aureus. Two days later the incision was enlarged and a pocket opened into pelvis. A third operation was done one week later and new pockets were opened. Convalescence stormy. Discharged May, 1910, with a sinus. March, 1913, reports two operations for sequestra in another city and an operation for bone abscess of humerus. Now has small sinus and walks with slight limp.

CASE 77. Male, 9 years, March 2, 1913. One week ago hit left shin; somewhat sore that night. Two days later became swollen and next day left forearm and right elbow became swollen and tender. Patient had high fever and was irrational at times. Examination: Very sick boy; temperature, 104°; pulse, 120; leucocytosis, 22,000; lungs, with many râles. There was an abscess over the lower end of the left ulna and the lower end of the right humerus. All lower leg was much swollen, red, and tender from knee to ankle; X-ray, negative. Operation: Incision over tibia, and the periosteum found entirely stripped off. Abscess extending from popliteal space to ankle. Bone trephined and the medullary cavity found full of pus. Abscess also in center of left ulna, and lower end of right humerus trephined. Culture, staphylococcus aureus. Died on the fifth day with septic parotitis and multiple abscesses in the soft part (autopsy).

CASE 85. Male, 11 years, May 10, 1913. Six days ago fell, injuring right ankle. Next day ankle was painful. Two days later the patient was sick in bed with high fever, pain, chills, and delirium. Examination: Sick, delirious boy; mouth, foul; chest, negative; right leg swollen and tender over upper third of tibia; pulse, 120; temperature, 103°; leucocytosis, 18,000; X-ray, negative. Operation: Incision over tibia and the periosteum found entirely stripped off the whole length of bone by pus. Tibia divided in center and removed in two pieces. Culture, staphylococcus aureus. May 11, focus opened at the lower end of the left radius. May 13, focus opened at lower end of the left tibia. May 15, operation for osteomyelitis of eighth rib on left. May 14, operation for osteomyelitis of crest of left ilium. Patient has pyelitis. May 24, pericarditis with effusion. June 18, 590 ccm. of fluid withdrawn from left chest. June 26, 750 ccm. of fluid withdrawn from left chest. June 27, 900 ccm. of fluid withdrawn from abdomen. July 2, 1,000 ccm. of fluid withdrawn from right chest. July 31, operation for osteomyelitis at upper end of the right radius. X-ray shows evidence of abscess of the humerus. September 2, large peritonsillar abscess opened. February, 1914, operation for osteomyelitis at head of the left fibula. March, 1914, operation for osteomyelitis of first right metatarsal. All other wounds solid. April 25, 1914, bone-graft from crest of left tibia to defect where the right tibia has not regenerated. August, 1914, all wounds solid, bone-graft united at one end and increasing slowly in size.

CASE 96. Female, 7 years, six months, September 9, 1913. Five days ago without cause pain in the left hip. Since then sick and feverish. Examination negative except for hip. This was tender and all motions limited. Temperature, 101°; pulse, 100; leucocytosis, 30,000; X-ray, negative. Operation: Incision over trochanter, bone trephined; no pus, but culture showed staphylococcus aureus. Two days later operation for osteomyelitis of right fibula; bone trephined in five places. Five days later large abscess over ilium and most of the bone found destroyed. (This was apparently the original focus.) Slow convalescence. Two months later greater part of ilium removed. Two operations since for small sequestra. At present there is a discharging sinus at the hip; the fibula is well.

ACUTE LOCAL WITH BONE DESTRUCTION

CASE 18. Female, 2 years, April, 1910. Two weeks ago attack of fever and vomiting and right ankle became swollen. Examination: Red, tender swelling over the right heel and lower leg. Temperature, 103°; pulse, 140; X-ray shows osteomyelitis of os calcis. Operation: Incision over bone and trephine opening made. Considerable pus obtained. Culture, staphylococcus albus. Culture from blood, staphylococcus aureus and influenza bacillus. Died on the eighth day of meningitis and septicæmia. (Autopsy.)

CASE 58. Male, 3 years, six months, November, 1912. One week ago began to walk lame and complained of pain in the left leg. Some fever and fretful. Examination: Head of left tibia slightly thickened and tender. Temperature, 101°; pulse, 116; leucocytosis, 11,500; X-ray, negative. Operation: Incision over head of tibia, periosteum thickened, two trephine openings made and pus found in medulla. Bone went on to the formation of sequestra, so twelve weeks later subperiosteal resection of the upper third of the tibia was performed. Eight weeks later bone had re-formed and boy was walking on it. Three months after this he fell down stairs and broke the leg. Following this, although the fracture healed promptly, a sinus formed, and a sequestrum was removed in December, 1913. In July, 1914, the wound was solid and the leg normal.

CASE 61. Male, 26 years, December, 1912. One month ago, without cause, left arm began to swell and has been very tender and painful since. Examination: Middle third of humerus much swollen and tender. X-ray shows

two distinct cavities in bone with periostitis and marked thickening of the cortex. Operation: Three-inch incision, much new-formed bone about humerus. Abscess-cavity in the shaft opened. Culture, staphylococcus aureus. Wound healed in eight weeks, and although urged to come in patient did not report for sequestrotomy for eight months. He then refused operation. Fourteen months after first operation complained of no trouble and was working as a day laborer.

CASE 67. Male, 33 years, January, 1913. Four weeks ago packing case fell on his right knee. Shortly after he complained of severe pain and was laid up in bed for four days. Attempted to work but had to give up on account of pain. Examination: Lower half of right femur thickened and tender. Motions of joint normal. Temperature, 105°; pulse, 130; leucocytosis, 7,600. X-ray shows slight periostitis over the lower half of the femur. Operation: Incision over outer aspect of femur. Five trephine openings made, and medulla cavity found filled with pus. Culture, staphylococcus. Patient refused operation for sequestrotomy later, but was admitted to the hospital six months later with erysipelas, at which time many sequestra were removed. Wound solid in eight months from date of first operation, and the patient was well one year later.

ACUTE CASES, MILD LOCAL INFECTION, NO BONE DESTRUCTION

CASE 8. Male, 9 years, May, 1909. Three weeks ago he sprained the right ankle. Since then it has been swollen and tender, but he is able to walk with a limp. Examination: Over left internal malleolus is a red, tender swelling. X-ray shows a distinct cavity in the lower end of the tibia. Operation: Tourniquet. Three-inch incision over lower end of tibia and cavity opened, which contained pus. Cavity sterilized and filled with bone-wax. Wound closed without drainage. Wax began to discharge on the seventh day. Wound healed in four months. X-ray one year later shows no trouble with tibia.

CASE 10. Male, 38 years, June, 1909. In September, 1908, he suffered a severe attack of pain in right leg just below the knee and was confined to bed for three months. Pain recurred two months ago and the patient was operated upon at the hospital for osteomyelitis of the head of the tibia. Sinus healed in one month. Two weeks ago admitted for pain and tenderness over the head of the fibula. Operation: Two-inch incision over head of right fibula. Cortex removed and cavity found filled with granulation tissue. Cavity sterilized and wound closed without drainage. Healing by first intention. Culture, an unknown bacillus. Wassermann, positive. One year later patient reports that he is perfectly well and has had no trouble since operation.

CASE 20. Male, 13 years, September, 1910. One month ago a pimple formed on the outer side of left leg, just below knee, which broke spontaneously. There was little pain. Examination: There was a sinus over the head of the left fibula, extending to the bone. X-ray showed slight periostitis. Operation: Incision over head of fibula and abscess found in the soft part. Second incision over head of tibia and bone trephined, opening a cavity one inch in diameter. Wound cleansed and packed. Eighteen months later reports by letter that the wound healed promptly and he has had no trouble since.

CASE 40. Female, 12 years, May, 1912. Three days ago fell, injuring right leg. Since then has not been able to walk and suffered severely from pain at night. Examination: Lower third of right tibia swollen and somewhat tender. Temperature, 100°; pulse, 90; leucocytosis, 16,000; X-ray, negative. Operation: Tourniquet. Three-inch incision over lower end of tibia. Some hæmorrhage in the soft parts. The periosteum was found thickened. Two trephine openings were made in the bone and a small amount of bloody pus evacuated. The wound was packed. One year later the patient reports that wound healed promptly and she has no trouble since the operation.

CASE 41. Female, 4 years, May, 1912. Three days ago patient woke up in the night crying because of pain in the thigh. She has been feverish and restless ever since, and cannot stand or walk. Examination: Marked thickening of the great trochanter on the right. Motions were somewhat limited. Temperature, 103°; leucocytosis, 28,000. Operation: Three-inch incision over trochanter. Small amount of pus about bone. Trephine opening made and few drops of pus found in medulla. The cavity was packed. Culture, staphylococcus aureus. Healed in two months; well one year later.

CASE 44. Male, 7 years, May, 1912. Two weeks ago twisted his right leg. Since then he has had some pain which confined him to bed for the last three days, and he cannot walk. Examination: Motions of right knee perfect. There is a tender point just below tibial tubercle. Temperature, 101°; leucocytosis, 18,500. Operation: Two trephine openings were made in the medulla just below the knee. The cavity was filled with brownish looking material. The wound was packed. Culture, staphylococcus albus. The wound healed in six months. Well one year later.

CASE 48. Male, one year, six months, July, 1912. Twelve days ago baby awoke with pain in the right shoulder. Since then he has been fretful, somewhat feverish, and will not use arm. Examination: Considerable thickening of right humerus and about shoulder. Motion of joint perfect. There is some tenderness over the upper end of humerus. Temperature, 102°; pulse, 140; leucocytosis, 54,000; X-ray, negative. Operation: Two-inch incision over head of humerus. Medullary cavity opened with a burr, and pus found. Large abscess also in soft parts. Wound packed. Culture, staphylococcus aureus. Well one year later.

CASE 52. Male, 16 years, August, 1912. Pain in the right knee for two months. No trauma. Pain has not been sufficient to keep him in bed, but he walks with a cane. He has no fever. Examination: The upper end of tibia is swollen and tender, and there is slight thickening. Motions of knee perfect. X-ray shows thickening upper third of tibia with a question of an abscess cavity in the head of the bone. Operation: Incision over upper part of tibia. Periosteum thick. Cortex over head of bone removed, opening large abscess cavity. Cavity sterilized, dried, and filled with bone-wax. On seventh day after operation sinus formed with a discharge of the wax. Wound healed in five months. Well eighteeen months later.

CASE 63. Female, 11 months, December, 1912. Ten days ago, without cause, the child became restless and the mother noticed that the left shoulder was sore. Three days later the shoulder became red and swollen. Diagnosis of scurvy made, but has not improved under treatment. Examination: Poorly nourished; left shoulder swollen and tender. Temperature, 101°; leucocytosis, 21,000. X-ray shows some change in the upper end of humerus. Operation: Incision over deltoid carried to the bone. Trephine opening made into medulla. No frank pus found. Culture, pneumococcus. Wound healed promptly and was reported well six months later.

CASE 68. See abstract in text.

CASE 70. Female, 17 years, January, 1913. Four weeks ago hit the right knee. The patient was treated for sprained knee, but joint soon became painful, and she was then treated for rheumatism and has been gradually getting worse. There was considerable pain and some fever.

Examination: Poorly nourished girl; considerable swelling around lower end of right femur, bone thickened and tender. X-ray shows slight thickening and periostitis of the lower end of femur. Temperature, 103°; pulse, 130; leucocytosis, 26,000. Operation: Four-inch incision over the inner side of the lower end of the femur. In the soft part an abscess containing a pint of pus was opened. Bone was bare of periosteum in one place. Trephine openings were made in the medulla which appeared normal. The wound was packed. X-ray taken four months later showed a small bone abscess in the lower end of the femur about one-half inch from the trephine opening. At the end of one year a sinus persisted and a second operation was done, opening and draining the bone abscess. The sinus still persists.

CASE 91. Male, 20 months, June, 1913. Five days ago fell, hurting his right shoulder. Since then he has been fretful and complains of tenderness and pain in the shoulder. Examination: Poorly nourished child, considerable swelling over upper end of right humerus; movements of joint free. X-ray shows some haziness about the head of humerus. Temperature, 101°; pulse, 120; leucocytosis, 35,000. Operation: Incision through deltoid to head of bone. Trephine opening made and pus under tension found in the medulla. Three openings made. Culture, streptococcus. The wound was packed. One year later a letter received from a friend says the child is perfectly well.

ACUTE PERIOSTEAL

CASE 47. Male, 64 years, July 2, 1912. Fifty-four years ago patient was operated on for abscess of the lower end of the right femur and a piece of bone removed. Five weeks ago he hit the same leg with a piece of timber, since which time the leg has been painful and tender. Examination: Lower end right femur swollen and tender on deep pressure. X-ray shows periostitis and slight thickening of cortex. Operation: An abscess in the soft parts containing pint of pus was opened and packed. Trephine opening made into medulla, but no cavity or sequestra found. Wound healed in two months. Well one year later.

CASE 69. Male, 26 years, January, 1913. Sick in bed three weeks ago with general pain, fever, and chills. Two weeks ago pain became localized in the right thigh and he has been unable to walk since. Examination: Poorly nourished man. Temperature 98.5°; pulse, 100; leucocytosis, 26,000. The right thigh is swollen, tender, and fluctuant from trochanter to knee. X-ray, negative. Operation: Six-inch incision outer aspect of thigh, and an abscess containing quart of pus evacuated. Trephine opening made into medulla at a point where cortex was bare of periosteum, but bone appeared normal. Culture, streptococcus. One year later patient reported well.

CASE 86. Female, 3 years, May, 1913. Six days ago fell, injuring right arm. The arm swelled and soon became painful. The patient was not very sick, but was sleepless and fretful. Examination: Over inner part of upper left arm a fluctuant, tender, red area. X-ray, negative. Temperature, 101°; pulse, 100; leucocytosis, 36,000. Operation: An abscess under the muscle and close to the periosteum was opened. The medulla was not trephined. Culture, streptococcus. Wound healed in eight weeks. No further data.

CASE 95. Male, 5 years, August, 1913. Ten days ago hit left knee, since which time he has had considerable pain, which has been gradually getting worse, keeping him awake at night. He cannot use the leg. Examination: Knee held slightly flexed and painful on motion; tender, fluctuant mass in popliteal spaces. Temperature, 102°; pulse, 100; leucocytosis, 42,000. Operation: Incision into large abscess in popliteal space, dissecting up the muscle planes to the internal condyle. Opening made in condyle and medulla appeared normal. Culture, streptococcus and staphylococcus. No further report.

CHRONIC DIFFUSE, LESS THAN 10 WEEKS' DURATION

CASE 52. Male, 4 years, July, 1912. Five weeks ago without cause became sick with fever, chills, and vomiting. Two days later the left leg became painful and swollen, and a local doctor opened an abscess, which has been discharging since. Examination: Poorly nourished child; left leg flexed at knee and painful on motion; all lower leg much thickened and tender. Opening of several sinuses over tibia. X-ray shows osteomyelitis with involucrum of practically entire tibia. Operation: Incision entire length of tibia, and the shaft removed subperiosteally to the epiphyses. Some involucrum left attached to the periosteum. In January, 1913, the bone had re-formed from the epiphyses, but no regeneration had taken place in the center of the shaft, there being a gap of about three inches. April, 1913, bone was grafted, graft being taken from the crest of the right tibia. July, 1913, the graft was solid, and the patient can bear weight on the leg. September, 1913, the patient can walk on the leg; no shortening.

CASE 53. Male, 13 years, October, 1912. Two months ago received a blow on the right shin. Three days later the leg became painful and the boy was very sick with fever, vomiting, chills, and pain in his leg. The local doctor at this time opened a superficial abscess, which is still discharging. Examination: Poorly nourished, sick boy; all right lower leg much swollen, thickened, and tender; several discharging sinuses. X-ray shows osteomyelitis of the tibia, with a destruction of the entire shaft of the bone. Operation: Incision from knee to ankle and entire shaft of tibia removed subperiosteally. July, 1913, bone was reformed and patient is walking on leg; no shortening.

CHRONIC DIFFUSE CASES, 3 MONTHS TO ONE YEAR DURATION

CASE 12. Female, 14 years, July, 1909. Six months ago, without cause, the patient had an attack of pain in the right knee. Two weeks later two abscesses broke in the center of the thigh and later a third one broke higher up. These have discharged since and patient has been gradually losing weight and strength. Examination: The right knee was held flexed and motion was much limited. Entire thigh thickened with opening of several sinuses. X-ray shows osteomyelitis of the entire shaft of the femur with much new-formed involucrum surrounding sequestra. Operation: Incision in the outer side of the thigh eight inches long, and much involucrum and several sequestra removed. Further operation abandoned on account of the patient's poor condition from loss of blood. December, 1909, large abscess opened over the trochanter, several pieces of bone removed. Patient also had erysipelas. February, 1910, abscess opened just above knee and sequestra removed. March, 1910, several sequestra removed from center of shaft. In July, 1911, a sinus persisted, through which much bare bone could be felt. In May, 1912, the wounds had been solid for three months and the knee can be flexed to an angle of about 90 degrees. May, 1913, patient has been well since last note. Walks without limp.

CASE 26. Female, 3 months, February, 1911. Two months ago had an abscess of the right leg, which was opened one month ago by a local doctor and considerable pus evacuated. Sinuses persisted. Examination: Poorly nourished sick looking baby. On upper side of right thigh two scars, each one inch long. Thigh swollen and tender. X-ray shows osteomyelitis involving entire shaft of the femur. Operation: Incisions at upper and lower end of femur opening abscess cavities. Later two sequestra were

removed. Wound healed in about four months. Well one year later.

CASE 29. Male, 6 years, April, 1911. In September, 1909, injured his left leg and three days later ankle became sore and swollen. Following this an abscess broke at the internal malleolus. In August, 1910, a sinus persisted, which was curetted out and some dead bone removed. Following this the wound healed for three months. Examination: All tibia thickened with opening of several sinuses along the crest, through which dead bone could be felt. X-ray shows large sequestra and upper two-thirds of tibia surrounded by much involucrum. Operation: Three-inch incision over upper end of tibia and several large sequestra removed. No further data.

CASE 39. Female, 5 years, April, 1912. Ten months ago kicked in the ankle and a few days later had an attack of pain and swelling. At this time the local doctor opened an abscess. One month later another abscess was opened below the head of the fibula. Two months later was told she had osteomyelitis with destruction of the whole fibula, but parents refused operation. In March, 1912, one month ago, several pieces of dead bone were discharged through persisting sinus. Examination: Sinus of upper and lower end of fibula on the left; entire lower leg seems thickened. X-ray shows fibula thickened and several sequestra apparently lying in abscess cavities. Operation: Incision the entire length of the fibula. One sequestra four inches long removed with considerable involucrum and several smaller ones. Wound healed in five months. One year later patient was well, walked without limp, and complained of no further trouble.

CASE 88. Male, 44 years, June, 1913. In October, 1913, had many boils on his neck. In November, 1912, had a severe attack of grippe, which was accompanied by pain and swelling of his left leg. Three months later a local doctor made an incision over the outer aspect of the leg and removed a piece of dead bone. Since then several small abscesses have broken. Examination: Multiple sinuses over all left fibula. Entire bone seems thickened. X-ray shows several sequestra and considerable new-formed involucrum. Operation: Multiple cavities and several small sequestra found and a large sequestra found in the lower end of fibula. Wound healed in about eight months. Well one year later.

CHRONIC LOCAL, THREE MONTHS' TO ONE YEAR DURATION. BONE DESTRUCTION

CASE 34. Male, 9 years, March, 1912. Six weeks ago the patient suffered an attack of headache, with pain in the joints, prostration, and fever. Later both ankles, both knees, and the right elbow became much swollen. The patient also developed a pericarditis and ran a temperature from 97° in the morning to 103° at night. Three weeks ago an abscess formed about the right ankle, which was opened. Examination: Poorly nourished and sick boy; knees, ankles, and right elbow swollen and motions painful. Incision over lower portion of right tibia. X-ray shows osteomyelitis, lower third of right tibia with considerable new-formed bone. Operation: Four-inch incision at lower end of the right tibia and four trephine openings made to medulla. One year later the sinus persisted. A second operation was done and a large cavity in the lower end of tibia opened and drained. One year after this second operation the patient was well, walked without limp, and leg presented but little thickening.

CASE 35. Female, 4 years, March, 1912. Ten months ago the child fell, striking left elbow. This elbow became red and tender, and three weeks later an abscess broke, which has discharged until the present time. Examination: Left elbow swollen; motions somewhat limited; sinuses over lower end of humerus. X-ray shows large cavity containing sequestra in the lower end of the humerus. No involvement of joint. Operation: Incision over external condyle and large cavity opened. Two sequestra were removed. The wound was packed. Well one year later. Extension of arm somewhat limited; flexion perfect.

CASE 36. Male, 11 years, April, 1912. Six months ago left shoulder became painful without cause, and shortly after an abscess broke, which has discharged ever since. Examination: Motions of shoulder somewhat limited and several discharging sinuses about upper part of humerus leading to the bone. X-ray shows osteomyelitis of the upper third of the humerus with sequestra and considerable involucrum. Operation: Three-inch incision through deltoid and a large sequestrum removed. The cavity was packed. Well one year later. Motions of joint good.

CASE 42. Female, 20 years, May, 1912. Six years ago the patient was treated for typhoid fever. Three weeks later definite symptoms of osteomyelitis developed and the right hip was operated upon. Two months ago the left thigh became swollen and tender, and an abscess broke a short distance above the knee. X-ray shows cavity containing sequestrum at center of left femur. Operation: Incision over center of left femur, bone trephined, and abscess-cavity found and drained. Small sequestrum removed. Wound closed without drainage, healing by first intention. One year later wound solid, no symptoms.

CASE 75. Nine months ago hit left shin. Five months ago had sudden pain over left lower leg followed by swelling. There was considerable fever with chills. Later a superficial abscess over the head of the tibia was opened by a local doctor and it has discharged ever since. Examination: Sick boy; several sinuses over upper half of the left tibia extending to bare bone. X-ray shows many cavities in upper portion of tibia with several sequestra and a large amount of involucrum. Operation: Many abscess-cavities in head of tibia opened and several sequestra removed. The wound was packed. The wound healed in ten months. Well sixteen months after operation.

CASE 80. Female, 17 years, March, 1913. In July, 1912, patient had septic thumb. In August, 1912, she had an acute attack of pain in the left knee, which has caused her to walk lame ever since. In December, 1912, an abscess broke in Scarpa's triangle. At present she has a sinus and walks with a limp. Examination: All left thigh thickened; red indurated mass in Scarpa's triangle with a fluctuating center. X-ray shows thickening of upper half of femur with many cavities and several sequestra. Evidently an old extensive process of mild virulence. Operation: Incision of upper half of femur and large abscess opened. Bone trephined and several sequestra removed from a definite cavity. The wound was packed. Culture, staphylococcus aureus. All sinuses closed in eight months. Well one year later.

CASE 87. Male, 14 years, June, 1913. In June, 1912, little toe of right foot became painful and an abscess formed. The bone was scraped three months ago, but two sinuses have persisted. Examination: All motions of ankle limited. Two sinuses over lower end of fifth metatarsal and the entire bone thickened. X-ray shows necrosis of fifth metatarsal and considerable new-formed bone. Operation: Sequestrum and some involucrum were removed. The wound was packed. Well one year later. Patient walks without limp.

CASE 93. Male, 16 years, July, 1913. Carbuncle on nose November, 1912; pneumonia, December, 1912; "psoas abscess" in March, 1913, followed by empyema in May, 1913; in January, 1913, pain in left upper arm, which has continued ever since with periods of remission; two weeks ago an abscess broke. Examination: Poorly devel-

oped sick boy; scar in right groin, discharging empyema sinus on right; two discharging sinuses over head of left humerus. Temperature, 101°; pulse, 120. X-ray shows cavity in the humerus three inches below head with a sequestrum. Considerable periostitis. Operation: Bone approached through incision between heads of biceps, cortex trephined, and abscess-cavity opened, sequestrum removed, and wound packed. Culture, staphylococcus aureus. Three months later large abscess developed in a popliteal space. One year later osteomyelitis of humerus well. The patient has had an operation since for an acute osteomyelitis of the lower end of the radius. Empyema sinus persists.

CASE 97. Male, 9 years, September, 1913. Three months ago following chill in swimming had an attack of pain followed by swelling of left side of his jaw. He was very sick for two days. One week later local doctor opened an abscess at the angle of the jaw, and later extracted the first and second molars. Examination: Left side of face much swollen; sinus at site of third molar tooth. X-ray shows osteomyelitis of the angle of the jaw with a cavity containing sequestrum. Operation: Cavity opened, sequestrum removed and wound packed. No further trouble.

CHRONIC CASES SEVERAL YEARS' DURATION, DIFFUSE AND LOCAL

CASE 1. Male, 28 years, September, 1908. Twelve years ago had an acute osteomyelitis of the tibia and two operations were performed in Greece. He was well for three years and for the last nine years has had abscesses break on the leg every few months. Examination: Right lower leg swollen and brawny. Red and tender area over the middle two-thirds of tibia. X-ray shows bone much thickened and several cavities. Operation: Four-inch incision, cortex removed, and several cavities filled with pus, opened and packed. No further data.

CASE 22. Male, age 20, October, 1910. "Erysipelas" of the leg when nine years of age. Since then has had many abscesses of the left lower leg. Six months ago was operated upon for osteomyelitis of the left tibia and abscess-cavities in the medulla opened. The sinus healed one month ago. Two weeks ago pain and tenderness returned. Examination shows a red tender area over the middle third of tibia. The bone is much thickened. Operation: Cortex removed and two abscess-cavities found in the medulla below the site of the previous operation. Cavities cleansed, dried, and filled with bone-wax. Closed without drainage. Wound opened with the discharge of wax one week later. Healed in four months. Well one year later.

CASE 45. See abstract in text.

CASE 46. Male, 28 years, June, 1912. Had bone-abscess when five years old and pieces of dead bone were discharged from abscesses of the right humerus, scapula, femur, and tibia. Sick for eight years, but perfectly well since, until six months ago, when abscess broke four inches below right knee. Examination: Scars of old abscesses. Opening of two sinuses below right knee. X-ray shows entire tibia much thickened with a cavity in the upper third. Operation: Cavity in the medulla filled with granulation tissue and cleaned out. Flap of skin, fascia, and fat swung in from the side, filling the cavity. The wound healed in a short time. One year later wound was healed but patient complained of pain in the lower part of the tibia. Operation: Abscess of the medulla in lower third of tibia opened, and an operation similar to first performed.

CASE 55. Male, 46 years, October, 1912. When 13 years old had a typical attack of osteomyelitis of the right tibia. Sinuses persisted for three years, after which they healed. Well until three years ago, when an abscess formed at the lower end of the tibia. This discharged a short time, and then healed. Three months ago a second abscess formed and was opened. Examination: All right tibia thickened, and leg showed multiple scars. Sinus at lower third of the tibia. X-ray shows cortex of entire tibia thickened with periostitis and an abscess-cavity in the lower third of the bone. Operation: Cortex removed, opening abscess of medulla in lower end of tibia. Cleaned out and flap of skin swung in from the side to fill the cavity. Wound healed in ten weeks. Well one year later.

CASE 60. Male, 24 years, November, 1912. Seven years ago had a typical attack of osteomyelitis of the right tibia and was operated upon in Greece. Discharging sinus for two years, but well for the last five years. Two months ago an abscess formed over the lower end of the tibia, which was opened. Examination: There were many scars over the right tibia. The bone was much thickened. X-ray shows much cortical thickening, cavity at lower third of tibia. Operation: Abscess of medulla at lower end of the tibia opened, bone at the sides removed, transforming the cavity into a shallow trough. Two sequestra also removed. Skin-flap swung in from the side. Healed in nine weeks. Well one year later.

CASE 62. Female, 41 years, December, 1912. Suffered an attack of acute osteomyelitis of the ulna when 12 years old. Several pieces of bone were discharged from sinus at that time. Well until four years ago, when the patient had rheumatism in the arm, which subsided in a few weeks. Two weeks ago the pain in the arm returned and has been very severe. Examination: Tender scar over lower two-thirds of left ulna. X-ray, lower portion of ulna appears normal. The upper two inches is thickened and contains two cavities. Operation: Eburnated bone over upper portion of ulna removed and two small cavities opened. Cavity sterilized with carbolic acid and alcohol, allowed to fill the blood-clot and wound closed without drainage. Healing by first intention. Well one year later.

CASE 72. Male, 62 years, February, 1913. An attack of acute osteomyelitis when 12 years old, following a fall. Both femurs, both tibiæ, and the right humerus involved. Patient has had to use crutches since on account of ankylosis of knee and restricted motions of hips and ankles. Ten years ago abscesses formed and broke on both ankles. Five years ago the right patella was fractured. For five months patient has been sick in bed with rheumatism of the left thigh. Examination: Multiple scars over bones mentioned above; right knee flexed and ankylosed; motion of hip limited; feet badly deformed. X-ray of left femur shows the lower end much thickened, with a question of an abscess in the medulla. Operation: Four-inch incision over lower end of left femur. Cortex removed and large abscess opened and packed. Culture, staphylococcus aureus. Wound healed in six months. Well two years later. Symptoms relieved.

CASE 73. Male, 62 years, February, 1913. An acute attack of osteomyelitis of the right tibia when 18 years old. Sick for two years, but sinus healed after the discharge of a piece of dead bone. Several similar attacks since. Well now for twenty-two years. Four months ago he had an attack of rheumatism in the right ankle, which has persisted. Examination: Right tibia much thickened and leg presents multiple scars, considerable redness and tenderness about ankle. X-ray shows cortical thickening and several small abscess-cavities in the lower end of the bone. Operation: Abscess opened, sides of cavity cut away, and skin-flap swung in from the side. Well one year later.

CASE 79. Male, 44 years, March, 1913. When 12 years old patient had an attack of acute osteomyelitis, originating in the right femur. Both tibiæ, right femur, and a rib involved. In 1909 a sequestrum was removed from the femur. In 1911 the right knee was excised and the

joint was disintegrated. Union was poor and several abscesses have formed since. Patient desires amputation, as the leg is short and useless. Operation: Amputation of thigh.

CASE 49. Male, 58 years, July, 1912. When a boy the patient had an abscess below left knee following trauma. A piece of bone was discharged, after which the sinus healed. One and one-half years ago the second abscess broke, which was curetted. A sinus has persisted since. The last four days the patient has had great pain in the leg and severe prostration. Examination: Patient has erysipelas. Is also a "cardio-renal" and has chronic bronchitis. There is a sinus over the head of the tibia. X-ray shows large abscess-cavity in the head of tibia. On account of the patient's general condition no operation was performed. One year later the sinus persisted, but the man had been working regularly as a day laborer.

CASE 59. See abstract in text.

BONE ABSCESS, LESS THAN ONE YEAR DURATION

CASE 4. Male, 15 years, May, 1909. Hit the right knee four months ago and has been in bed ever since with rheumatism. Examination: A tender red area over the head of the left tibia; bone seems much thickened. X-ray shows marked thickening of the head of the tibia with some periostitis and an abscess-cavity in the medulla. Operation: Abscess in soft part opened; cortex removed, and abscess in the head of tibia opened, sterilized, and filled with bone-wax. Culture, staphylococcus aureus. Wound opened with the discharge of wax in a few days. There were some pus pockets in soft part during convalescence. Wound healed in five months. Well one year later.

CASE 16. Male, 16 years, February, 1910. Four months ago a boil formed and broke just below the left knee. This healed shortly, but a second abscess broke below it. For the last month he has had severe pain in the leg and has been unable to walk. Examination: Red, fluctuant area below the left knee; head of tibia thickened; four inches below the knee there is an opening of a sinus. X-ray shows two separate cavities occupying the upper third of the tibia. Operation: Cavities opened, sterilized, and filled with bone-wax. Culture, staphylococcus albus and aureus. The sinus persisted ten months. Well two years later.

CASE 24. Male, 15 years, December, 1910. Eight months ago following a fall the patient had severe pain in right thigh, which was swollen and painful for two weeks. The pain has been worse recently. Examination: On upper external aspect of right thigh is a red fluctuating, tender area. X-ray shows some periostitis and a bone abscess a short distance below the trochanter. Operation: Abscess opened and cavity packed. Culture, staphylococcus aureus. Healed in seven months. Well eighteen months later.

CASE 32. Male, age 48, May, 1911. Blow on left knee ten months ago. Following this knee became swollen and tender and two operations were performed on the femur at another hospital. The sinus closed, but one week ago the knee became swollen again and an abscess broke. Examination: Two sinuses over lower end of right femur. Knee slightly flexed and motions very much limited. X-ray shows cavity in the lower end of the femur with considerable corticle thickening. Knee-joint is evidently involved. Operation: Incision over outer aspect of the lower end of the femur, medulla trephined, and bone abscess drained. Cavity cleaned out and filled with bone-wax. Culture, sterile. Several pockets of pus in the soft parts during convalescence. Wound drained for eight months. Well two years later. (X-ray.)

CASE 81. See abstract in text.

BONE ABSCESS OF SEVERAL YEARS' DURATION

CASE 2. See abstract in text.

CASE 5. Male, 14 years, May, 1909. Acute attack of osteomyelitis when four years old and since then abscesses have broken about once a year. Ten previous operations. Examination: Many scars over both tibiæ, right radius, left humerus, and a rib; lower third of right tibia is swollen, tender, and fluctuant. X-ray shows typical bone abscess four inches above lower end of right tibia. Surrounding bone is not much thickened. Operation: Cortex removed, cavity opened, cleansed, and filled with bone-wax. Culture, staphylococcus aureus. The wound was closed without drainage. A week later the sinus opened and wax was discharged for some time. Well thirteen months later, but letter unsatisfactory.

CASE 6. Male, 30 years, May, 1909. Twelve years ago following trauma patient had osteomyelitis of the lower end of the femur. Three operations were performed in Sweden, after which the sinuses healed. One month ago the pain in the leg returned, keeping the patient awake at night. Motions of the knee were limited. Examination: Scar on inner side of femur just above knee, lower end of bone thickened and tender. X-ray shows abscess-cavity in lower end of femur surrounded by thickened bone. Operation: Abscess opened and packed. Following operation the patient had repeated hæmorrhages and the hæmoglobin dropped to 35 per cent. Three years later sinus persisted, and the condition was the same as before operation.

CASE 7. Male, 26 years, May, 1909. Nine years ago, without cause, the left knee became swollen, and later an abscess broke. The patient was in bed nine weeks. He was well for two years. For the past seven years an abscess has formed at the lower end of the femur every six months. Examination: Left ankle swollen, red, and tender. X-ray shows an abscess-cavity in the lower end of the femur, and cortex much thickened. Operation: Cavity opened, cleansed, dried, and filled with bone-wax. Wound closed without drainage. Culture, staphylococcus aureus. A sinus formed in a few days with a discharge of the bone-wax. The wound healed in six months. Well one year later.

CASE 11. Male, 23 years, June, 1909. Seven years ago, without cause, an abscess formed in the right knee with a discharge of pus. Operation three years ago, at which time a sequestrum was removed. Well until three months ago, when the abscess broke again. Examination: There is a sinus over the head of the tibia leading to bare bone. X-ray shows typical bone-abscess cavity in head of tibia. Operation: Large cavity in head of tibia opened and packed. Following operation knee-joint became infected, necessitating resection later. One year later the osteomyelitis is well. The patient can walk, but the knee is stiff.

CASE 14. Male, 36 years, November, 1909. When 14 years old the patient had an acute attack of osteomyelitis of the right "foot" and upper end of right humerus. Five years later and two years after that another abscess formed. Patient is well now for fifteen years. Two weeks ago, following trauma, he had an attack of acute pain in the right foot. Examination: Over head of first metatarsal is a red, tender, fluctuant area. X-ray shows bone abscess in head of first metatarsal. Cavity opened, cleansed, allowed to fill with blood-clot, and the wound closed without drainage. A sinus formed one week later. No further report.

CASE 17. Male, 36 years, March, 1910. Eight years ago he had an attack of pain in the right upper arm. One year ago he was operated upon for osteomyelitis of the humerus and a cavity was drained. Seven weeks ago the arm became swollen again and a sinus formed. Examination: At the center of the right humerus is a tender, red area;

the bone is thickened. X-ray shows two connecting cavities in center of humerus. Operation: The cavities were opened, sterilized, and filled with bone-wax. The wound was closed without drainage. Following operation the patient had complete paralysis of the brachial plexus, which lasted three weeks. The wound was opened shortly after with a discharge of serum and wax. Ten months later the pain in the arm recurred and X-ray shows the cavities as before operation.

CASE 21. Male, 22 years, October, 1910. Four years ago an abscess formed on the right ankle and broke. The wound healed and the patient was well until six months ago, when the ankle became painful and swollen. The pain has persisted until the present time. Examination shows slight thickening at lower end of the right tibia and scars of previous operation. X-ray shows bone abscess at lower end of the right tibia. The abscess was opened, sterilized, filled with bone-wax, and the wound closed without drainage. A sinus formed a short time later, discharging serum and wax. No further report.

CASE 25. Male, 35 years, February, 1911. Acute osteomyelitis 20 years ago involving both tibiæ and both humeri. One year ago an operation was performed on the right tibia. Two months ago an abscess on the left shoulder broke but healed promptly. Examination: There is considerable thickening around the head of the left humerus. X-ray shows a typical abscess-cavity of the head of the humerus with a considerable thickening of the cortex. The abscess was opened, the cavity sterilized, allowed to fill with blood-clot, and the wound was closed with a small drain. Healed in three months. Nine months later an abscess broke in the scar. One year after this patient reported well. Culture, staphylococcus aureus.

CASE 28. Female, 17 years, March, 1911. Attack of acute osteomyelitis in the lower end of the femur six years ago following a fall. Two previous operations. Examination: There is a sinus above the knee on the right; the bone is thickened. X-ray shows the bone much thickened, probably masking a cavity in the medulla. Operation: Large abscess-cavity in the medulla opened, cleansed, allowed to fill with blood-clot, and closed with a small drain. Culture, staphylococcus aureus. The sinus healed in about six months. One year later pain returned and an X-ray showed an abscess as before. A second operation was done and the abscess packed. The sinus persisted, and at the end of the next year a third operation was done, and a flap of the muscle swung in obliterating the cavity in the bone. The sinus closed in about six months. Well a year and a half later.

CASE 30. Female, 30 years, April, 1911. Four years ago, without cause, patient had an attack of rheumatism in the right shoulder. Two years ago had a similar attack. Three months ago pain returned and has persisted. Examination: Some spasm of muscles over right shoulder and little limitation of motion. X-ray shows two distinct cavities in the upper end of the humerus and the cortex thickened. Operation: In the upper end of the humerus were two cavities which were filled with pus. These were opened and packed. The wound healed in two months. Abscess recurred six months later.

CASE 57. Male, 19 years, October, 1912. When four years of age had erysipelas and osteomyelitis of the left humerus. Well until five weeks ago, when, without cause, he had an attack of pain in the left arm. Examination: Lower third of humerus tender and swollen. Motions of joint free but painful. X-ray showed abscess-cavity three inches above the elbow, cortex not thickened. Operation: Abscess opened and cavity obliterated by a flap of muscle from the triceps. Culture, staphylococcus aureus. Sinus persisted for six months. Well one year later.

CASE 71. Male, 30 years, February, 1913. When six years old had an abscess of the left shoulder followed by a discharging sinus for six years. No trouble until three years ago, when an abscess formed and a sinus has persisted. For three weeks has had severe pain in the left shoulder with chills and fever. Examination: Well developed, sick man. Temperature 103.5°; pulse, 130; leucocytosis, 26,000. Opening of sinus near axilla on the left and two scars over the head of the left humerus. X-ray shows upper end of humerus much thickened, and probably containing an abscess-cavity. Operation: Incision through deltoid, large abscess of soft parts opened, cortex removed, and abscess in head of humerus drained and packed. Convalescence stormy. Abscesses formed on the right forearm, over left fibula on the left thigh, in right groin, in the abdominal wall, and right axilla. Patient also developed panophthalmitis, with a loss of left eye. Culture from all abscesses, staphylococcus aureus; blood culture, sterile. Eight months later general condition good, but persistent sinus over left shoulder.

CASE 74. Male, 28 years, February, 1913. When 13 years old had an attack of pain about center of right humerus, and for the past ten years has had occasional similar attacks. Four years ago an abscess broke at this point, which healed. Four months ago pain returned and has been present since. Examination: Scar at center of right humerus. X-ray shows marked thickening of cortex, probably masking an abscess-cavity. Operation: Incision over outer side of humerus, cortex removed, and large abscess in center of bone opened. Flap of triceps swung into cavity, obliterating it. Culture, sterile. Healing was by first intention. No further report.

CASE 84. Male, 20 years, April, 1913. Ten years ago injured right ankle. One year later foot became swollen and painful, but symptoms subsided in two weeks. This has happened about every six months since that time. Examination: Negative, except for tender point behind external malleolus. X-ray shows small cavity on the outer posterior part of the tibia. Operation: Cavity opened with difficulty, sterilized, and packed. Culture, no growth. Wound healed slowly with some pocketing of pus in the soft parts. No further report.

CASE 90. Male, 24 years, June, 1913. Abscess of left leg 15 years ago, which has broken open seven times since. Eight years ago patient had an abscess in right flank; five years ago he had an abscess on the right leg; three and one-half years ago he had an abscess over the right ilium. Three years ago an operation was performed for bone abscess at center of the left humerus. Three weeks ago he had severe pain over left arm. Examination: Scars at sites of old abscesses; left humerus about center swollen, red, and tender. X-ray shows large bone-abscess cavity occupying upper two inches of humerus. Operation: Incision through deltoid, cavity opened, and found full of pus. Much cortical bone was removed. The cavity was packed. Culture, staphylococcus aureus. The wound healed in three months. Well one year later.

CASE 92. Male, 17 years, June, 1913. Three years ago injured right thigh while playing football. Three months later an abscess was opened. One year later the left foot pained him and an abscess formed at that point. One year ago he had pain in left knee following strain, which has been getting steadily worse. Examination: Upper end of left tibia thickened and slightly tender. X-ray shows a very large abscess at the upper end of the tibia. Operation: Abscess-cavity two by four inches and containing six ounces of pus in the head of tibia opened. Sides of cavity cut away and skin-flap swung in an attempt to obliterate it. Healing was slow; wound closed in about nine months, but small abscess has broken twice since then.

BONE ABSCESS, "RESTING" CASES

CASE 13. Female, 38 years, August, 1909. Two years ago, without cause, had severe pain in center of left tibia. Similar attacks have occurred every two to four months since. Examination: Slight tenderness at center of left tibia with some thickening of bone. X-ray shows a definite cavity at center of tibia with some thickening of the surrounding bone. Wassermann, negative. Operation: Cortex removed and several cavities filled with clear fluid, opened, sterilized, allowed to fill with blood-clot, and closed without drainage. Healing was by first intention. Eighteen months later reports she is well. X-ray at this time shows normal bone and no cavity.

CASE 38. Female, 23 years, April, 1912. Injured left ankle when six years old, following which an abscess broke. This healed, after the discharge of dead bone, in about two years. Since then repeated attacks of pain in the right shin after hard work. Examination: The right leg is one-half inch shorter than the left. At the upper third of the tibia the bone is thickened but not tender. Scars over lower end of that bone. Wassermann, negative. X-ray shows cortex much thickened, no evidence of cavity. Operation: Incision over upper third of tibia, cortex removed, and cavity one and one-half inches long filled with clear fluid and containing a small sequestrum, opened, sterilized, allowed to fill with blood-clot, and closed without drainage. Healing was by first intention. Well fifteen months later.

CHRONIC PERIOSTEAL

CASE 19. Male, 25 years, July, 1910. In 1895 had typhoid fever. Three weeks later abscesses broke in several parts of the body, which later discharged small pieces of bone and then healed. Sinuses about right hip, however, persisted. Since then has had six operations for osteomyelitis of right femur without cure. Examination: Motions of left hip limited, opening of a sinus in groin. X-ray shows thickened irregular bone about trochanter and neck of femur. Operation: Considerable involucrum and several sequestra removed from the upper end of left femur. The cavity was packed. The sinus discharged for a year after operation, when two sequestra were discharged and the wound healed. The wound has now been solid for over a year.

CASE 37. Male, 21 years, April, 1912. Five years ago injured left thigh. Following this had more or less constant pain in the left hip, and one year later was operated upon and the bone scraped. He was perfectly well for two years, when an abscess opened and a sinus has persisted since. Examination: Scar over right trochanter with opening of the sinus, through which dead bone may be felt. X-ray shows no cavity in the bone, but slightly thickened cortex and roughened periosteum over the trochanter. Operation: Incision over bone and abscesses of soft parts at head of trochanter extending into the bone. The cavity was cleaned out and some bone removed. The wound closed with small drain. Reports 18 months later that the wound healed in a few months and has been well for over a year.

CASE 78. Male, 33 years, March, 1913. Three years ago, without cause, had a severe attack of pain in the left femur below the trochanter; sick twelve weeks. Well until five months ago, when pain returned and leg became swollen. Leg tapped by doctor, who drew out a pint of pus. Examination: Pupils normal, knee jerks present; over left femur below trochanter a fluctuant swelling; motions of knee limited. X-ray shows cortex of bone near trochanter very much thickened, suggesting syphilis. Repeated Wassermann tests, negative. Operation: Incision over femur and two pints of clear fluid found directly over the bone. The cavity was lined with granulation tissue and extended from knee to trochanter. The periosteum was thickened and fibrous. Incision into medulla, which appeared normal. The wound was sterilized and closed without drainage. Culture, staphylococcus aureus. Three weeks later X-ray showed process more marked in bone and fluid had reaccumulated. A sinus formed later. One year later patient reports that sinuses have persisted. Advised to have further X-rays and treatment, but refused.

CHRONIC EPIPHYSITIS

CASE 23. Male, 7 years, October, 1910. Eight months ago kicked in the right heel by a horse. Shortly after this an abscess formed at this point, which healed but broke open again a few weeks ago. Examination: Right heel swollen and tender. On inner side, opening of the sinus, and X-ray shows disease of the epiphysis of the os calcis. Operation: Cavity in epiphysis curetted and packed. Well two months later. One year later reports no trouble.

UNCLASSIFIED CASES

CASE 51. Male, 14 years, July, 1912. Nine months ago had an acute attack of osteomyelitis of the left tibia, and a subperiosteal resection was done six weeks later. A large portion of the shaft of the tibia, however, at the two ends was not removed, and these are present now as sequestra. The middle third of the tibia has regenerated. Operation: Several sequestra removed from the upper and lower end of tibia with considerable involucrum. Wounds healed in a few months. One year later wounds solid, no shortening of leg, and patient walks without limp.

CASE 38. Male, 5 years, February, 1912. An acute attack of osteomyelitis of the right tibia ten months ago. Six weeks later a portion of the shaft of the tibia was excised, but a piece of bone was left at the upper and lower end, and sinuses have persisted since. Operation: Large sequestra removed from upper and lower end of tibia. Wound packed. Wound healed in six weeks. One year later wound solid, no shortening of leg, and no symptoms.

SECONDARY CASES

CASE 31. Male, 23 years, May, 1911. Tuberculosis of head of third metacarpal bone. Patient also has tuberculosis of lungs. Cavity in bone cleaned out, filled with bone-wax, and wound closed without drainage. A sinus formed later, discharging wax. The wound healed in six weeks. Well one year later.

CASE 56. Male, 7 years, October, 1912. Tuberculosis of rib. Abscess over chest broke when 2 years old, and a sinus has persisted since. Examination: The fifth rib at junction with the costal cartilage is necrotic. Operation: One and one-half inches of the fifth rib excised and wound closed without drainage. Healing was by first intention. Well one year later.

CASE 65. Female, 30 years, December, 1912. Tuberculosis of spine. A case of streptococcic infection of a large tubercular abscess of the back. Abscess opened and patient transferred to orthopedic department.

CASE 76. Female, 19 years, March, 1913. Tuberculosis of right femur. Pain in right knee, without cause for four months, which has confined her to bed for some time. Some loss of weight and night sweats. Examination: General condition poor. Right thigh swollen and fluctuant. Temperature, 101°; pulse, 120. X-ray shows lower end of femur thickened and a probable abscess at about center of shaft. Operation: Abscess in soft parts, containing two pints of pus, opened. The cortex was removed and a small abscess in the center of the bone opened and packed. The wound did not do well and many abscesses opened in the soft parts in the next month. Patient also developed a large abscess of back. Died in two months. Autopsy showed tubercu-

losis of lung, spleen, adrenals, small intestine, spine, and femur.

CASE 83. Male, 30 years, April, 1913. Tuberculosis of femur. Operated upon one year ago for osteomyelitis of right femur, but was not relieved. Operation: Large abscess in soft parts opened and cavity in trochanter drained. Specimen removed showed tuberculosis. Patient was not relieved and hip-joint amputation was performed six months later. At present he still has a sinus, but his general condition is better.

CASE 89. Tuberculosis of first left metatarsal and third right metatarsal bone. Wassermann, negative. Skin tuberculin test positive. Transferred to orthopedic department.

CASE 94. Female, 11 years, August, 1913. Tuberculosis fifth metacarpal. Abscess over outer side of right hand seventeen months ago, which has been discharging ever since. Examination: The fifth metacarpal is thickened and there is a sinus at the center of the bone. Wassermann, negative. X-ray showed cortex thickened and two cavities in the bone. Operation: Large cavity opened and found filled with caseous material and granulation tissue. Cavity cleaned out and packed. Healed in five weeks. Well one year later.

CASE 3. Male, 7 years, January, 1909. Sepsis following fracture of tibia. Large cavity opened and fragment of bone removed from lower end of tibia. Accidental death shortly after operation.

CASE 82. Male, 15 years, April, 1913. Osteomyelitis following fracture of tibia. Nine months ago broke both bones of left leg at the lower third. Three months later had erysipelas of that leg, at which time an abscess broke at the site of the fracture. A sinus has persisted since. Examination: There is some thickening at the site of the fracture and opening of the sinus. X-ray shows definite cavity in tibia. Operation: Cavity in medulla of tibia, one by two inches in diameter, opened. Flap of skin swung into cavity from side. In the next six months patient had erysipelas twice. One year later the sinus had closed and the patient walked without limp.

CASE 9. Male, 67 years, June, 1909. Necrosis of metatarsal in diabetic patient. For six weeks has had an ulcer over the ball of the great toe on the left. Examination: There is an indolent ulcer, at the bottom of which bare bone can be felt. X-ray shows necrosis of head of first metatarsal. Operation: Necrotic bone removed and wound packed. The wound healed in five weeks. Well one year later.

CASE 27. Male, 23 years, May, 1911. Osteomyelitis from direct extension of sepsis. Septic hand two years ago. Since then has had two sinuses in palm of hand. Examination: Three sinuses present over third metacarpal bone. X-ray shows necrosis of entire bone. Operation: Excision of finger and metacarpal bone. Following operation there was a streptococcic infection of the hand and arm. The patient was very sick for six weeks. One year later the wound was solid and motions of finger good considering the sepsis. A useful hand.

CASE 33. Female, 22 years, May, 1912. Osteomyelitis from direct extension of sepsis. Osteoma at head of tibia removed four years ago. Following this a sinus formed and three operations were performed for osteomyelitis of the head of the tibia. Examination: Scar below knee; patient walks with slight limp and complains of constant pain over head of tibia. X-ray shows a cavity in the head of the bone. Operation: Cavity cleaned out and flap of skin swung in from the side, obliterating the cavity. Tip of flap sloughed, but wound healed in five weeks. Well one year later.

CASE 64. Male, 43 years, December, 1912. Osteomyelitis from direct extension of sepsis. Three years ago had a septic bunion of the left foot. Six months ago injured his foot again and was in bed eleven weeks with a discharging sinus. Examination: First great toe and first metatarsal on left have been removed. A sinus was present over scaphoid, extending to dead bone. Many other scars on the foot. Wassermann, negative. Operation: Incision over scaphoid and part of the bone is apparently necrotic. Bone curetted out and cavity packed. Well one year later.

CASE 54. Male, 22 years, October, 1912. Syphilis. Pain in left knee for two years without cause. It has never been severe, but it has kept him from work at times. He is worse at night and walks with slight limp. Examination: Upper third of left tibia tender and slightly thickened. An X-ray shows marked thickening of cortex of the upper third of the tibia. Wassermann, strongly positive. Salvarsan. Well one year later.

CASE 66. Female, 7 years, January, 1913. Syphilis. Four weeks ago had an acute attack of pain in the right leg, followed by tenderness and swelling over the skin. Examination: Poorly nourished colored girl. Tibia thickened, tender, and skin seems hot. X-ray shows marked periostitis of center of shaft; no evidence of disease of the medulla. Temperature, normal; pulse, 80. Macular rash on lower extremities. Wassermann, strongly positive. Salvarsan. No further report.

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# INTESTINAL STASIS[1]

By SIR BERKELEY MOYNIHAN, M.S., F.R.C.S., Leeds, England

IN a discussion upon "intestinal stasis" a single speaker can touch only very lightly upon any particular aspect of this most interesting problem. The literature which has already accumulated is so vast, and the claims made as to the importance of the condition are so far-reaching, that anything in the nature of a close criticism of the matter having regard to brevity is impossible.

It is asserted, (*a*) that certain bands, webs, veils, or membranes are present at defined points in the alimentary canal; (*b*) that these adhesions are responsible for delay in the onward transmission of the intestinal contents, and consequently for increased decomposition in them; and further, that the organisms so proliferating, or other noxious products, are absorbed into the system and produce certain deleterious effects; (*c*) that certain disorders are due exclusively to the toxæmia which comes from such absorption, or from subinfection, and that a very large number of the diseases to which man is liable are also harmfully influenced thereby.

What truth is there in these various statements? Of the existence of various membranous adhesions along the course of the alimentary canal there can be no doubt. Between the duodenum and the gall-bladder or the under surface of the liver, at the duodenojejunal flexure, at the end of the ileum, along the ascending colon, at the hepatic and splenic flexures, and to the outer side of the pelvic colon they are plainly and frequently to be seen. Their origin is not yet certainly ascertained, and it may indeed not always be the same. Certainly many of them are congenital. When in 1899 I published my work on "Retroperitoneal Hernia," I had examined the abdomens of a large number of fœtuses, children, and young adults, in order to discover the number, nature, and extent of the peritoneal fossæ. I found, and there recorded, the fact that adhesions of the proximal jejunum and the terminal ileum were not seldom found in these cases, and that they were due to the condition described by Toldt as "physiological fusion." The membrane which binds the ascending colon so loosely to the posterior abdominal wall—Jackson's membrane, as it is called, though Lane not only described but depicted it—has a vascular supply of such regular appearance that it seems impossible that it should be anything other than a developmental relic. The origin of the band at the hepatic flexure, and of the more obvious and thicker string-like adhesion at the splenic flexure, is probably, as Lane asserts, the result of traction and the effort to restrain or overcome its effects. Of the existence of these several membranes, therefore, there is no doubt. There is little doubt, also, that they are for the most part congenital though mild inflammatory processes; or the response of the parts to dragging force applied to them may be responsible for their increased development. If the supports of the bowel were in need of reinforcement it is probable that strength would be added to membranes already existing rather than that entirely new bands should be laid down. When once these adhesions are formed they may, of course, hamper the free action of the intestine.

It is often said that in cases of intestinal stasis an obstruction exists at the site of one or another of these bands, and that long delay of the contents of the bowel is caused thereby. This does not tally with the general operative experience. Every surgeon who has much experience of the intestine in these cases will agree that as a rule the wall of the gut is thin and almost translucent; it is not, as we see it in cases of veritable obstruction, thick from hypertrophy of its muscular wall. It is feebleness of action rather than impediment which causes the tedious transit of food. The walls of the gut are thin, the membranous supports are of such poor quality that parts normally well-fixed like the splenic flexure can often be withdrawn from the abdomen,

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and the musculature of the abdominal wall is flaccid and feeble. Everything indicates that a sort of apathy is, as a rule, the cause of stagnation, not an obstruction which is with difficulty overcome.

We may therefore take it as proved that the various bands described in connection with the intestine do exist, though we may dispute as to their origin; we may agree also that undue delay in the forward transmission of the intestinal contents does occur, and that this delay is accompanied either by a form of subinfection, by organisms in varying degrees of attenuation escaping from the intestine, or by a form of intoxication.

What are the clinical results of all this? In the recognition of a certain type of patient whose ills are solely dependent upon intestinal stasis we shall all probably be in agreement. The victim of what we may call "Lane's disease" is now easily recognized, and the symptoms are caused to disappear by appropriate surgical treatment. The symptoms are strikingly repeated in case after case. The patient is generally a woman of unhealthy aspect and attenuated figure. She is lean, cadaverous, flat-chested, and she has a sour breath and cold and clammy hands. The skin is harsh and of an earthy color and bears many crops of pimples; its secretion is apt to be distressingly noticeable. She makes complaint of "indigestion," pain after meals, flatulence, and inveterate and incoercible constipation. The abdominal muscles lack bulk and tone. They are flabby and flaccid, and all the viscera which they should hold up are fallen in greater or less degree. Mentally, there is often a complete absence of the joy of life: the patient is a morose, querulous, and often suspicious and introspective person. These attributes are rarely all present together, but so many of them may coexist as to enable a distinct type of patient to be recognized. In the very obvious cases of this kind I do not think the mild measures that can often usefully be employed for the novice — massage, abdominal exercises, and the unrestricted use of paraffin — are really of any value. These sufferers are properly cases for surgical treatment. The colon should be excised in whole or in part. In some, perhaps, ileosigmoidostomy may be done; but in every case, with one exception, in my own series there has been some regurgitation of the intestinal contents upward along the descending colon to the cæcum. The stasis then is worse than before, for a mass of fæcal material that is never wholly dislodged is palpable at all times. The symptoms, which are nevertheless relieved in great measure, are clearly not due merely to the stagnation of the bowel contents. No method of anastomosis, nor any fashioning of new kinks, can wholly prevent this backward flow, though something can doubtless be done to lessen the tendency to it. Personally, I believe that nothing short of colectomy offers a substantial chance of cure. How much of the colon is to be removed? This invites a consideration of the function of the large gut. It is well known that putrefaction goes on much more largely in the lower ileum than in the large intestine; but it is not improbable that in the cæcum and ascending colon absorption takes place more freely. The liquid contents delivered through the ileocæcal valve are moved backward and forward in the ascending colon and rapidly lose a good deal of the fluid matter. "We drink with the large intestine." The ascending colon has possibly other uses: of excretion or even of internal secretion. The hind gut, which begins in some part of the transverse colon supplied from the anastomosis magna of Riolan, is only for the storage and expulsion of the fæcal masses full of bacteria, mostly dead, delivered to them. The part of the gut that needs removal is therefore, I think, the last part of the ileum, the cæcum, and the ascending colon. Accordingly, in such patients who need surgery I prefer to do Friedrich's operation of resection of these parts of the bowel.

It is, on the whole, an advantage to have the descending colon and the pelvic colon left. Absorption barely goes on at all from these parts, for we know that a simple injection of saline fluid introduced into the rectum rapidly finds its way around to the cæcum. If the descending colon and the sigmoid flexure are too lengthy, a suggestion of Mr. Gray's may be adopted. Making

use of the principles of mobilization and displacement, to which I called attention, he loosens the hind gut from its moorings and displaces it upward; so that what was the pelvic colon becomes now the descending colon, and the latter is made to occupy the place of the transverse colon. This operation is simple, very satisfactory in its results, and in my hands has, as yet, had no mortality. Its advantages over complete removal of the colon appear to be that all the maleficent part of the intestinal tract is removed, and that enough of the bowel remains to avoid the teasing and troublesome diarrhœa which is known to follow at times upon the larger operation. Moreover, the number of raw stumps of ligatured vessels is fewer, and their "peritonization" is far more complete than when all the colon is taken. Finally, some of the omentum is left, and in a territory given over at times to riot the presence of the "abdominal policeman" is possibly a witness to peace. It is known that a great menace, perhaps the greatest, attaching to the operation of complete colectomy is the occurrence of obstruction afterward. The raw surfaces left by so great a denudation of the posterior abdominal wall, and by the vessels which have been tied in the various mesenteries, afford easy opportunity for tethering adhesions to form and cause obstruction. Friedrich's operation allows of very adequate "peritonization" of all the rough places left and closure of the gaps between the divided ends of the mesentery.

The patients whose condition and appearance I have just described very often undergo a most marvellous rejuvenation after operation. They gain in weight and glow with health; life changes its color, and vivid interest and keen enjoyment succeed to apathy and languor.

In dealing with the clinical aspects of intestinal stasis we are, so far, upon firm ground. We can pick no quarrel with the enthusiasts. What further part does intestinal stasis play as a causative factor in any disease? What influence has it, for example, upon the development of gastric and duodenal ulcer, and upon the various phases of cholelithiasis?

Many surgeons have realized, and some of us long have taught, that in a great many cases these common disorders of the upper abdomen are not to be considered as isolated and primary diseases; the view should rather be held that they are secondary expressions of a primary lesion elsewhere, and that they are often linked together by a common antecedent, if not evoked by a common cause. There is much evidence to show that they are secondary to some infection, within or without the abdomen. For some years past I have held the view that the appendix is the test-tube in which organisms are propagated which, by a process of subinfection, express their ravages in the form of ulceration in the stomach or in the duodenum. A gall-stone, as we know, is merely an invading army of organisms coated by the missiles with which they have been bombarded. Sir Arbuthnot Lane believes that the chronic inflammation of the appendix itself is also secondary — the result of the causes which are associated also with stasis in the intestine. I regret that I cannot accept his view as tenable, except in a small proportion of the cases. In the great majority we do not find intestinal stasis, nor the Lane kink or veil, nor indeed any of the customary evidences of intestinal stasis to which he has called attention, whereas we do find the most positive evidence of appendicular disease. For the last few years when operating for a chronic gastric or duodenal ulcer or for gall-stones, I have made, in all proper cases, a careful search at the site of the various obstructing membranes we now so easily recognize, and I am compelled to assert that the evidence of stasis, or of the demonstrable conditions upon which it so often depends, is not to be found in more than a very small proportion of the cases. Moreover, the recovery of the patient who, for example, has had gastro-enterostomy done for a duodenal ulcer, is so speedy, so complete, and so enduring that it is a sheer impossibility that any lingering disease remains behind. We must put this matter definitely, for recently I have heard of patients with declared duodenal ulcer who have lost their lives through operations directed to the relief, not of the ulcer, but of a wholly supposi-

tious intestinal stasis. For gastric ulcer, for duodenal ulcer, and for cholelithiasis, no operation should be sanctioned which does not deal directly with the parts involved. To perform colectomy or ileosigmoidostomy in such cases is, I think, to exceed our right and to neglect our plain duty.

So far as concerns a great variety of other diseases, it is claimed that intestinal stasis is either the sole cause or a contributory cause of such significance that all other causes can be neglected or dismissed.

In diseases of the joints, for example, rheumatoid arthritis, or tuberculous disease, stasis is held to be the essential indispensable factor causing the harm, or at least permitting it to take place. And the treatment of the severer forms, at least, of both diseases does not occupy itself with a direct assault upon the joints affected, but with the intestine from which all the evil has started. Cases are reported, and are shown to us, in which such treatment has had an effect beyond all one's wildest imagining. I have myself seen many cases of advanced — indeed, apparently hopeless — tuberculous disease of the hip-joint, or of the wrist or shoulder, in which an arrest of the quickly destructive processes took place almost at once when the colon was removed or a short-circuiting operation performed. And a sensible improvement has followed also in a few cases of rheumatoid arthritis in which, while nothing was done directly to the joint, the whole colon was excised. Of the occurrence of such events there can be no question. They do not, indeed, stand alone. Rheumatoid arthritis, as we all know, is a disease with many causes, with many aspects, with many vagaries, and with many equal responses to many different forms of treatment. We know little of the disease except that it is often, possibly always, the result of a chronic infective process at work somewhere in the body, producing effects at a distance. In the old days of surgery the earliest certain manifestation in pyæmia was the affection of distant joints. Rheumatoid arthritis is pyæmia moving slowly. Probably every surgeon knows something of chronic joint diseases which undergo striking improvement when factories of infection are closed down. I have cured not a few cases of "rheumatoid arthritis," by draining the gall-bladder, which produced the poisons to which the joints reacted. Of the occurrence of a few equal improvements after colectomy I am fully cognizant; but I am also aware of many cases that have showed little or no permanent relief.

Of tuberculous diseases of the joints the same may be said. Without question, there is some improvement in some cases, much improvement or even cure in a few. But the bulk of the cases, so far as I can judge, are not appreciably affected by operation upon the intestine. Moreover, I have known of cases in which tuberculous disease of the hip developed after ileosigmoidostomy had been performed, and it is at least of some interest to know that a patient upon whom colectomy was done fell a victim afterward to phthisis, from which, however, recovery took place.

The evidence at the moment available allows us certainly to say that intestinal stasis does seem to stand in a causal relationship toward some cases of chronic joint affections, and that such cases exhibit a marked and instantaneous delay or even cessation in the destructive processes, after operation upon the bowel, and that a complete recovery of the joint ultimately occurs. What is uncertain is not the existence of such cases, but their frequency. So little has been done in this direction, and so few surgeons have lent themselves to this form of treatment, that we cannot do other than withhold a confident opinion. The experience of the few, however, is worthy of a wider proof at the hands of other surgeons, in carefully selected cases.

But the enthusiasts ask us to travel with them even further than this. We are told that a very large number of diseases need have but little attention paid to their local outcry. This should call attention, not to the seat of pain, but to its cause, which lies in the intestine. To name a few of these diseases is to show the length to which we are invited to go. Exophthalmic goiter, trigeminal neuralgia, various forms of functional and organic disease of the heart, diseases of the breast, of the thyroid gland, of the pelvic organs of the female, and finally cancer;

these are only a few of the diseases which are due, it is said, to stasis in the intestine. The claims are many, the proofs few. We ask for evidence, and if we know something of the work that has been done and of the really striking results that have already been achieved, we shall be prepared to consider the evidence, absurd though it may appear at first, with an eager anxiety to do justice to new views.

In medicine the new idea is slow to gain currency. We are a conservative race; and we all find criticism a more facile process than creation. Recent experiences in more than one branch of medicine will hardly persuade us to change our faith. Too much is claimed for every new advance. Vaccines were to rid us of many diseases; now the removal of the colon is to check all diseases that it does not cure outright. In the face of such exaggerated pretentions we do well, perhaps, to go warily; but we must surely go with open minds. For there is no intellectual sin more deadly than sloth of the imagination. I have thought many hours, read much, and worked not a little at this subject of intestinal stasis, and have tried to clear my eyes for the new vision opened to us by Sir Arbuthnot Lane. My experience has been full of surprises: old beliefs, so slow to perish, have been undermined, and new faiths, so slowly fashioned, have been painfully accepted. And now I do not hesitate to say that the whole question is one which will have to be considered by all of us and to be put to the proof. It cannot be dismissed with a shrug or a sneer, for there is truth in the matter. Among much that is dross there lies a nugget of pure gold.

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## THE TREATMENT OF THE SECOND DEGREE OF PELVIC CONTRACTION

By HENRY JELLETT, M.D., F.R.C.P.I., Dublin, Ireland
Master of the Rotunda Hospital

IN the second degree of pelvic contraction, the true conjugate measures between two and three-fourths and three and one-fourth inches in a flat pelvis, or between three and three and one-half inches in a generally contracted pelvis. In this degree it is usually only possible for a living child to be born through the vagina if either the size of the child is below the normal or the size of the pelvis is increased; that is to say, either premature labor must be induced, or pubiotomy or symphysiotomy must be performed.

Accordingly four courses are possible: First, the induction of premature labor, in order to get a smaller child; second, the enlarging of the pelvis, by pubiotomy or symphysiotomy at term; third, cæsarean section at term; and fourth, craniotomy. It is unnecessary to refer to the last, because I think modern obstetricians are practically universally agreed that perforation is only permissible in the case of a dead child, except under the most exceptional circumstances.

The different advantages and disadvantages of the three remaining lines of treatment are as follows: First, comes the induction of premature labor. The advantages of this procedure, in my opinion, are not very numerous, and consist principally in the fact that it is comparatively easily carried out, and that it usually results in the birth of a living child. On the other hand, the arguments against it are, first, that it is an operation in which it is extremely easy to infect the patient during the process of induction; secondly, that all methods of induction recommended up to the present are uncertain in their action, and sometimes mean repeated manipulation and considerable delay; and thirdly, that the premature child is very liable to die in consequence of its feeble condition. I am sure there are many who will consider that I am underestimating the

advantages and overestimating the dangers of this procedure; but still I am inclined to state as my deliberate opinion that the induction of premature labor in the second degree of pelvic contraction is not the treatment of choice, although it sometimes may be the treatment of necessity.

The second possible line of treatment is cæsarean section. In favor of this operation are a considerable number of points. In the first place it is very simple and easily carried out. If it is done early in labor or before labor has begun, it is almost free from risk. There is no such thing as vaginal or perineal laceration; recovery is rapid; there are none of the pains and discomforts of a prolonged labor, and the fœtal prognosis is usually entirely good. Lastly, it can be performed in subsequent labors, probably as often as is required, provided no abdominal infection occurs. In fact, so far as I can see, it only possesses two disadvantages, but these are serious. If we are to get all the benefits of cæsarean section without the dangers, it must be performed either before labor begins or early in the first stage, and consequently it is not possible to give the patient an opportunity of delivering herself. The second disadvantage is the result of this; namely, that when once a cæsarean section is done on a patient on account of contracted pelvis there is no logical reason why it should not have to be done in every subsequent pregnancy. In short, one may say once a cæsarean section always a cæsarean section. This is a serious disadvantage, because it is not always possible to measure a pelvis so very exactly as to be able to say that it falls positively into a certain degree, and, even if one can measure it so exactly, one is not able to estimate correctly the actual size of the fœtal head. Practical experience shows that in the second degree of pelvic contraction, or in border line cases between the first and second degrees, it may be entirely impossible to deliver, through the vagina, a living child at one labor, whereas in the next labor, with stronger uterine contractions and greater moulding of the head, it is possible to effect delivery. If, however, a woman is to be delivered by cæsarean section, the operation must be done at an early period of labor, so losing all possibility of spontaneous or instrumental delivery.

The third possible line of treatment of these cases is pubiotomy. In favor of this operation are the facts that it is a smaller procedure than is cæsarean section in a favorable case; that its performance can be postponed till the last possible moment, when a positive indication for delivery on behalf of either the mother or the child arises, and that consequently every opportunity of spontaneous delivery or of delivery by the forceps is afforded; and that it improves directly the prognosis of subsequent labors, because it causes a permanent increase in the size of the pelvis. On the other hand, the operation possesses certain disadvantages. In the first place, the antecedent labor is prolonged and painful, and, during it, the child may possibly die, owing to compression, even though it is most carefully watched. Further, it is always liable to cause laceration of the vagina and possible injuries to surrounding parts, and consequently in unfavorable cases it may prove to be a much more difficult operation than is cæsarean section. One has, therefore, to consider carefully whether the possible risks of a pubiotomy are or are not counterbalanced by its advantages. I am of opinion that the advantages are considerably in excess of the disadvantages. First, because the fact that the operation can be performed late in labor gives the patient every opportunity of escaping any operation, and secondly, on account of the extremely beneficial effect of pubiotomy on subsequent labors. To explain the reason for my belief it is necessary to place before you in a series of tables the statistics of the cases of pubiotomy which have been performed at the Rotunda Hospital, both by my predecessor, Dr. Hastings Tweedy, and myself.

Table I, following, gives a general statement of these cases.

The second table shows the nature of the different complications which occurred during the performance of pubiotomy or subsequently, and from it will be seen that in four out of the nineteen cases there was what might be regarded as a serious complication. In

TABLE I

| No. | Name | No. of Labor | Nature of Previous Labors | Pelvic Measure C.V. Cm. | Pelvic Measure T. Cm. | Date | Operator | Result Mother | Result Child | Weight of Child, lbs. | Nature of Susequent Labors. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | E. L. | I | | 6.5 | 10 | Nov., 1906 | Dr. Tweedy | A | A | 7½ | II. Craniotomy.<br>III. Extraperitoneal cæsarean section; alive; 9½ lbs.; November, 1909.<br>IV. Classical cæsarean section; alive; 7¾ lbs.; July, 1912.<br>V. Classical cæsarean section; alive; April, 1914. |
| 2 | C. S. | V | I. Breech; dead<br>II. Ditto<br>III. Miscarriage<br>IV. Breech; alive, but died | 7.5 | 12 | Mar., 1907 | Dr. Tweedy | A | D | 6¼ | VI. Spontaneous; alive; 8½ lbs.; April, 1909.<br>VII. Spontaneous; alive; 7¼ lbs.; May, 1910.<br>X. Spontaneous; impacted breech; alive; very large; March, 1914. |
| 3 | B. G. | IV | All difficult; forceps, version, etc. | 8 | 11.5 | May, 1907 | Dr. Tweedy | A | A | 8¾ | |
| 4 | E. B. | I | | 7<br>On Re turn<br>8.5 | 10.5<br>10.5 | May, 1907 | Dr. Tweedy | A | A | 7¾ | II. Spontaneous; alive; 7½ lbs.; May, 1908. |
| 5 | S. F. | IV | I. Forceps; dead<br>II. Induction 33rd week; child alive; 3 lbs.<br>III. Induction 36th week; version; dead; 5¾ lbs. | 7 | 11.5 | June, 1907 | Dr. Tweedy | A | A | 10 | |
| 6 | M. D. | III | I. Symphysiotomy; dead; July, 1907<br>II. Abortion | 8 | 12.8 | Sep., 1910 | Dr. Tweedy | A | A | 6¾ | |
| 7 | R. N. | I | | 8.5 | 12.4 | Nov., 1909 | Dr. Tweedy | A | A | 8 | II. Spontaneous; alive; 8½ lbs.; July, 1912. |
| 8 | M. O'T. | IV | Forceps; children still-born | 7 | | Oct., 1910 | Dr. Tweedy | A | A | 7⅝ | V. Transverse podalic version; dead; 6¼ lbs.; Jan., 1913. |
| 9 | M. C. | III | Perforation | 8.3 | 13 | Nov., 1910 | Dr. Tweedy | A | A | 7 | IV. Spontaneous; breech; alive; 8½ lbs.; March, 1914. |
| 10 | M. K. | II | | | | Nov., 1910 | Dr. Jellett | A | A | 6¾ | |
| 11 | M. B. | IV | I. Forceps; alive<br>II. Normal; alive<br>III. Normal; alive | 7.2 | 12.4 | Mar., 1911 | Dr. Jellett | A | A | 6¾ | V. Forceps; alive; June, 1912. |
| 12 | K. B. | I | | 7 | 12.5 | Mar., 1912 | Dr. Jellett | A | A | 6¾ | II. Placenta prævia; hydramnios; internal version; dead; 6¼ lbs.; March, 1913. |
| 13 | M. W. | II | | | | June, 1912 | Dr. Jellett | A | A* | | |
| 14 | C. O'C. | I | | 7.3 | 9.3 | Aug., 1912 | Dr. Jellett | A | A | 7¼ | II. Spontaneous; alive; 8 lbs.; Feb., 1913. |
| 15 | M. R. | III | | 8.5 | | Apr., 1913 | Dr. Jellett | A | A | 8⅝ | |
| 16 | R. M. | II | I. Spontaneous; premature; alive | 9.4 | 8.8 | Apr., 1913 | Dr. Jellett | A | A | 8¼ | |
| 17 | R. S. | IV | I. Forceps; alive<br>II. Brow; version; lived few minutes.<br>III. Brow; forceps; lived 1 hour | 9.1 | 11 | Aug., 1913 | Dr. Jellett | A | A | 9½ | |
| 18 | M. G. | IV | I. Forceps; alive<br>II. Spontaneous; dead<br>III. Forceps; dead | | | Nov., 1913 | Dr. Jellett | A | A | 10½ | |
| 19 | M. C. | V | I. Forceps; lived 1 day<br>II. Forceps; lived few minutes<br>III. Craniotomy<br>IV. Craniotomy | 8 | 11.25 | Apr., 1914 | Dr. Jellett | A | A | 10 | |

*A died in 10 minutes. Hydrocephalic and spina bifida.

all of them, however, the ultimate recovery was perfectly satisfactory. The tear of the bladder-wall was sutured at the time and healed completely. The patient in whom crural phlegmasia occurred was quite well when she left the hospital. The two cases in which necrosis of bone occurred require some explanation. The piece of bone which necrosed was the piece lying between the saw-cut and the symphysis, and in both these cases this piece came completely away. It is interesting and important to note that in neither case was there any interference with the patient's power of locomotion subsequently, and I consider that they clearly demonstrate that failure of union of the bone at the site of incision in no way interferes with locomotion.

The third and fourth tables show the difference between labors which occurred previous to the performance of pubiotomy and labors which occurred subsequent to pubiotomy. These statistics are most important and deserve careful study. It will be seen from them that, whereas in twenty-nine labors previous to pubiotomy only three children were delivered alive spontaneously, subsequent to pubiotomy out of fifteen labors eight children were delivered alive spontaneously. The three cæsarean sections performed after pubiotomy were all done in the same patient, and from the first table, one sees that in this case pubiotomy had been done in a patient whose conjugate diameter was less than that recognized as the normal minimum for pubiotomy, namely, 7 cms.

In conclusion, I would like to offer my opinions as to the treatment of the second degree of pelvic contraction:

1. Pubiotomy is the operation of choice, unless there are special circumstances in the case or special complications present.

2. Pubiotomy is especially indicated in the young multipara, because of the effect of the operation on subsequent pregnancies, and because, owing to previous labor, the vaginal canal is dilated and lacerations are unlikely to occur.

TABLE II

COMPLICATIONS OF PUBIOTOMY

| | No. Cases |
|---|---|
| Tear of bladder wall | 1 |
| Necrosis of bone | 1 |
| Necrosis of bone and external hæmorrhage | 1 |
| Labial hæmatoma and crural phlegmasia | 1 |
| External hæmorrhage from vulvar veins | 5 |
| Uncomplicated | 10 |
| Total number of cases | 19 |

TABLE III

NATURE OF PREVIOUS LABORS

| Nature of Labor | Number | Result to Child | |
|---|---|---|---|
| | | Alive | Dead |
| Spontaneous | 7 | 3 | 4 |
| Induction | 2 | .. | 2 |
| Forceps | 11 | 3 | 8 |
| Version | 1 | .. | 1 |
| Symphysiotomy | 1 | 1 | .. |
| Craniotomy | 4 | .. | 4 |
| Difficulty unclassed | 3 | .. | 3 |
| Total | 29 | 7 | 22 |

TABLE IV

NATURE OF SUBSEQUENT LABORS

| Nature of Labor | Number | Result to Child | |
|---|---|---|---|
| | | Alive | Dead |
| Vaginal Delivery: | | | |
| Spontaneous | 8 | 8 | .. |
| Forceps | 1 | 1 | .. |
| Version | 2 | .. | 2* |
| Craniotomy | 1 | .. | 1 |
| Cæsarean section | 3 | 3 | .. |
| Total | 5 | 12 | 4 |

* One transverse presentation and one placenta prævia.

3. On the other hand, cæsarean section is more suitable in the elderly primipara, because vaginal laceration is more likely to occur, and because it is unnecessary in her to take account of future pregnancies.

4. Premature labor is only indicated under special conditions which render either of the foregoing operations impossible or inadmissible.

5. Craniotomy is only permissible when the child is dead.

# FURTHER EXPERIENCE WITH RESECTION OF THE ŒSOPHAGUS FOR CARCINOMA*

By WILLY MEYER, M.D., New York
Attending Surgeon to the German and Post-Graduate Hospitals

IN accordance with the suggestion previously made [1] that every case of resection of the œsophagus for carcinoma, be the outcome favorable or unfavorable, should be published by the surgeon performing the resection, a second series of such operations is herewith reported.

The case histories will be briefly and chronologically related and comments added.[2]

Case 5. Infiltrating carcinoma of lower half of intrathoracic œsophagus, including the portion behind the aortic arch. First stage: gastrostomy and inferior œsophagoplasty, making use of the major curvature of the stomach (Beck-Jianu). Second stage: thoracotomy; tumor has perforated through the œsophageal wall posteriorly, infiltrating mediastinum; transposition of proximal stump antethoracically, under skin; drainage. Death eleven hours after operation.

Woman, 44 years.[3] Increasing signs of œsophageal stricture for nine months; no solid food taken for last six months; sound locates upper end of stricture 9½ inches (24 cm.) behind teeth; according to X-ray findings narrowed portion evidently several inches long.

December 27, 1912, gastrostomy and inferior œsophagoplasty with needle and thread (Beck-Jianu—first case thus operated upon by author).[4]

Parenthetically I wish to state here that the operation proposed by Jianu [5] in 1912 was done first in 1905 and tested out on animals by Carl Beck of Chicago, assisted by Alexis Carrel. A report of the experiments was published in detail in the transactions of the Chicago Medical Society.[6] Jianu was evidently not aware of the American work done seven years before his own.

The new tube was placed below the pectoral muscles according to Roepke's advice.[7] It sloughed at the distal end, the silkworm sutures which were to hold the tube in place having been placed through the skin and the *entire* thickness of the new tube; *whereas only the mucosa should have been sutured*. There was partial necrosis at the distal end with subsequent suppuration, which spread to the rib-cartilages and sternum, greatly complicating the after-treatment, retarding convalescence and temporarily blocking further operative procedures. Regular feeding was given through a large tube, which was each time easily introduced for the purpose. The patient was given the ordinary solid food, which he masticated thoroughly and deposited in some warm fluid before it was gently pressed down into the stomach by means of a large hand syringe.

At the special request of the patient extirpation of the tumor was attempted. If this proved impossible, it was planned to do a palliative operation, dividing the œsophagus above the tumor, closing its distal end, and transposing the proximal portion antethoracically. Thoracotomy was performed May 22 under intratracheal insufflation (Dr. Eggers), Torek's incision,[8] in seventh interspace; four ribs were divided, somewhat to the outside of rib angle; good access. Infiltrating tumor extending from about one and one-half inches above cardia to a place fully one inch above aortic arch; many glands. Costal pleura incised and glands pushed off with gauze on handle; tumor exposed. As the left pneumogastric nerve can still be prepared off the tumor, radical operation is decided on. The right pneumogastric, totally involved, is divided. Mobilization of aortic arch by double ligature and division of intercostal arteries, thoroughly loosening costal pleura all around. On holding and retracting aorta with Langenbeck's hook sudden irregularity of heart; profound shock: Trendelenburg's posture; rib spreader, sponges, and tampons removed; insufflation under higher pressure; intravenous saline. Equilibrium gradually restored and operation continued; very careful handling of aortic arch with fingers. It is seen that right behind it the tumor has perforated the œsophagus and widely infiltrates posterior mediastinum. While examining local conditions the tumor was torn. Now operation could not be interrupted, but must needs be completed. Œsophagus-stump surrounded with gauze and clamped; division of tube above cardia between two silk ligatures, dividing it with cautery. Inversion of distal stump as usual. Following this, double ligature and division of œsophagus above upper end of tumor, which finishes removal of the tumor. With patient turned on back, proximal stump is now brought out of typical neck-incision

[1] Some observations regarding thoracic surgery on human beings. Ann. Surg., Phila., July, 1910.

[2] For first series, cases 1–4, see Surg., Gynec. & Obst., 1912, xv, 639.

[3] Ann. Surg., Phila., 1913, September, 290, Fig. 3.

[4] Ann. Surg., Phila., lc.

[5] Deutsche Zeitschr. f. Chir., cxviii, 383.

[6] Illinois M. J., 1905, vii.

[7] Zentralbl. f. Chir., 1912, No. 46.

[8] J. Am. M. Ass., 1913, May 17.

*Read before the seventeenth annual meeting of the American Gastro-Enterological Association, Atlantic City, June, 1914.

at inner border of sternocleido muscle above clavicle and is transposed downward under skin bridge, in direction of Beck-Jianu's tube-opening. Drainage of pleural cavity through ninth intercostal space. Complete closure of thoracic incision by layer sutures; differential pressure (positive)—after-treatment; at short intervals periods of rhythmic changes of pressure, producing variations of lung inflation equivalent to artificial respiration. In course of next few hours temperature rising; patient succumbs eleven hours after completion of operation. Post-mortem not allowed.

CASE 6. Cancer of œsophagus behind aortic arch. First stage: gastrostomy and inferior œsophagoplasty (Beck-Jianu) under venous anæsthesia. Hültl's wire-stitching instrument used. Second stage: thoracotomy. Tumor found inoperable; palliative operation; no drainage; sudden exitus eight hours after completion of operation.

Man, 68 years; typical, increasing symptoms of œsophageal stenosis for last six months; presence of tumor behind and somewhat below aortic arch proved by all the modern methods of diagnosis. March 24, 1913: gastrostomy and lower œsophagoplasty (Beck-Jianu) with the help of Hültl's wire-stitching instrument. Under venous ether anæsthesia patient is deeply narcotised in very short time. Median incision; omentum major adherent to anterior wall of stomach and liver, most likely due to former ulcerations. Beck-Jianu tube can be nicely and quickly formed by use of both the large and small wire-stitching instruments.[1] Assistant's blunt retractor injures liver, making an ugly tear. It is packed with gauze and tampon brought out of abdomen through special stab wound. Uninterrupted, smooth surgical recovery, but severe, typical ether-pneumonia sets in, rendering patient's condition critical for quite some time. Feeding with ordinary, well-masticated food, as in foregoing case. The gastrostomy opening is kept plugged with gauze between meals. Off and on some regurgitation of stomach contents. Surrounding skin well protected in order to prevent eczema; gains a few pounds in weight. In view of the long duration of the disease the patient insists on performance of second stage of radical operation, though made fully aware of its seriousness. June 3: Morphine-atropine hypodermatically; pre-operative subcutaneous instillation of saline 800 ccm. Irrigation of stomach; tube removed; opening plugged. Intratracheal insufflation (Dr. Eggers). Torek's intercosto-dorsal incision in eighth interspace; eighth to fifth ribs divided at angle; intercostal vessels surrounded by catgut ligature, centrally, before they are cut; splendid exposure; mobilization of aortic arch, whereupon it is seen that the tumor covers two to three inches of the œsophagus and forms a unit with posterior wall of aortic arch and bronchus; both pneumogastric nerves involved; extirpation impossible. Palliative operation, by dividing œsophagus well above upper end of tumor, viz., about two and one-half to three inches above aortic arch, inverting distal stump and transposing proximal through neck wound and under skin bridge in front of thorax. Ligature occluding proximal stump remains uncut. Neck wound closed without drainage, also entire chest wound, after bed of œsophagus and distal stump have been touched with 50 per cent tincture of iodine. Pulse at completion of operation 120; color of face satisfactory; returned to ward. Seven hours later sudden exitus.

Wound inspection: Neck wound puffed by serosanguinolent fluid and some air. On reopening chest, lungs appear well distended; only small amount of fluid in posterior mediastinum.

*Comment.* These two cases, 5 and 6, were found beyond surgical help. However, to develop this fact, it was necessary to open the thorax. They prove the uselessness of attempting radical removal of an infiltrating cancer from behind the aortic arch, if the cancer covers several inches of the tube and, according to the history of the case, has been growing for a number of months. Where such conditions prevail, only a palliative operation, consisting in antethoracic transposition of the proximal stump, should be performed, the tumor itself being left intact.[2] If the patient's general condition does not warrant such major, though only palliative, work, the operation remains an exploration.

CASE 7. Epithelioma of œsophagus between aortic arch and cardia. First stage, gastrostomy; second stage, thoracotomy; division of œsophagus below stricture; inversion of distal stump. Antethoracic transposition of proximal stump with tumor *in situ*. At first good recovery. Death on seventh day after operation from septic pleuritic effusion.

Man, 68 years; increasing difficulty in deglutition for last four to six months; has lost greatly in weight; chronic bronchitis; bougie finds stricture 13½ inches (34 cm.) behind incisor teeth; only fluids pass. January 22, 1914, Kader's gastrostomy, as patient seems too emaciated and weak to stand the Beck-Jianu operation. Large tube inserted; soon forced artificial feeding with full diet thoroughly masticated by patient and introduced with large hand-syringe. After some time able to swallow again well-chewed solid food. Nevertheless, continuous loss of weight. February 25, œsophagoscopy; two pieces removed for microscopical examination (Dr. Yankauer). Pathologic diagnosis: Squamous-celled epithelioma. (Dr. Humphreys). March 12: Thoracic operation. Hypodermic of one-quarter gr. morphine plus

[1] See J. Am. M. Ass., 1914, January 10.

[2] J. Am. M. Ass., 1914, January 10, Figs. 21 and 22, and Zentralbl. f. Chir., 1914, No. 2.

1-300 gr. atropine one hour before; stomach irrigated; tube removed; gastric fistula plugged and protected. Intratracheal insufflation (Drs. Eggers and Sanford). Torek's incision in eighth intercostal; four ribs upward divided between their angle and spine with Gigli's saw; works nicely. Lung not adherent posteriorly; abdominal spreader found best in holding thoracic wound apart. Localized tumor palpable about two inches below aortic arch; left vagus not involved; right tightly adherent; has to be cut; both cocainized with 1 per cent novocaine solution by intra- and perineural application; loosening of œsophagus to about one inch above cardia, can be well done; lifted up on twisted gauze; double silk ligature tied twice sufficiently far below tumor; division with electric cautery; careful cauterization of stump after separation; lower stump caught with bayonet clamp as close to cardia as possible; placing of purse-string suture with round needle and chromicized gut, taking hold of loops by pulling latter well apart; invagination easy; four securing top sutures, also with chromicized gut. Distal stump dropped; disappears in the depth. Then proximal stump gradually loosened; it is tightly adherent to right lung behind aortic arch; a number of ligatures are required, during which manipulation the right pleural cavity is opened. In order to reach œsophagus above aortic arch, the fourth rib also needs division. Now œsophagus is loosened, and, with gauze strip passed underneath, lifted well up. In order to loosen it all around, quite a number of ligatures behind aortic arch are required; vessels to be ligated can, however, be pulled into view without mobilizing arch. Then stump of œsophagus placed in front of arch and loosened in the mediastinum upward. Following this, typical neck incision; œsophagus hooked with forefinger and stump pulled out; it responds with a jerk; wrapped in moist, warm gauze. As lungs can be nicely inflated and the whole operation has been done with perfect asepsis, drainage of the pleural sac is not carried out as planned, but air-tight closure of thoracic cavity decided on and done, as always insisted on by Sauerbruch and seemingly affirmed by Torek's experience with his successful case. Closure of neck wound with interrupted silkworm; then length of healthy portion of upper stump measured on thorax, transverse incision of skin, formation of subcutaneous tunnel, transposition of tube antethoracically with tumor still in place; ligature around œsophagus fully one-half inch above upper border of tumor, clamp distally, division with cautery between. End of stump corresponds to second intercostal space. Corners of the transverse wound closed with silkworm, and muscular coat of œsophagus attached to skin by means of a few interrupted mattress sutures of catgut. Gauze dressing kept in place by adhesive plaster, avoiding pressure. Typical Desault-dressing fixates arm.

Operation as such lasted two hours and forty-five minutes; with suture and dressing, three hours and ten minutes. Pulse at completion, 96; patient awakes on operating table; brought to bed; no cyanosis; 9 P.M., pulse 84; gastric tube replaced. March 13, A.M. in good condition; P.M. sudden rise of temperature to 102.2°, diffuse bronchitis. March 14, good condition; 8 P.M. first change of dressing in order to open œsophageal stump; regurgitation of saliva was feared, which might cause aspiration during sleep; primary healing of chest-wound; projecting œsophageal stump necrotic; some swelling over tunnel of skin; posterior wound is not disturbed. March 15: Condition clinically satisfactory, temperature and pulse lower. March 16, A.M., returned to ward; P.M. first change of posterior part of dressing, fourth day after operation; a few necrotic spots in course of suture line; dullness over left lower chest, which, however, in view of the favorable clinical symptoms, is *not* considered due to presence of *infected* fluid; kidneys work all right; some cough and mucous expectoration. March 18, second change of dressing; dullness of same extension; tapped; sero-sanguinolent fluid of foul odor found; immediate opening of lower outer angle of chest wound, where subcutaneous swelling had appeared; pleural cavity entered by pushing dressing forceps forward; about one and one-half pint of same fluid evacuated; two drains; dressing; when returned to bed, cyanosis of lips, which had been slightly present before, increased; respiration more rapid. Patient returned under differential pressure in negative chamber; frequent rhythmic changes of pressure in chamber for artificial respiration, hypodermic stimulation, etc. Midnight, condition good; pulse, 90; rectal temperature, 99.8°; respiration, 20; March 19, A.M., condition satisfactory; differential pressure stopped to find out effect of ordinary breathing; little difference; pulse soft. No urine passed; bladder holds only a few drops; 4:30 P.M. sudden exitus.

Wound inspection: Entire lower pleural cavity, inclusive of posterior mediastinum, shows gray-black cover (infection). Tapped fluid had by this time grown streptococci and staphylococci; lower œsophageal stump had remained closed; no fluid in right pleural cavity; œsophageal stump below neck wound five and one-half inches (14 cm.) long; of this length lower end of four inches (10 cm.) necrotic; dividing line of living and necrotic œsophagus corresponds to clavicle; organ here probably kinked and pressed upon by bone; patient was very emaciated; had no fat whatever; heavy bones.

CASE 8. Cancer of œsophagus; stricture just behind aortic arch. First stage: gastrostomy and œsophagoplasty (Beck-Jianu). Second stage: thoracotomy, resection of tumor; exitus.

Man, well preserved; 50 years of age; trouble in swallowing for last six months; only fluids pass. Stereoscopic X-ray shows tight stricture corresponding to body of fourth dorsal vertebra. Sound finds obstruction 28 cm. behind incisor teeth. April 30, 1914, gastrostomy and inferior œsophagoplasty (Beck-Jianu). Stomach small; cannot be pulled

forward satisfactorily. In trying to bring it well in front of the abdominal incision, one of the vessels running perpendicularly on to the stomach from the left epiploic artery tears, and two bleeding points have to be ligated. Then major curvature exposed as usual and divided in horizontal direction with Hültl's wire-stitching instrument for inferior œsophagoplasty (see above). Care is taken to make the communication of the tube with the cardiac end of the stomach as small as possible; a transverse *superficial* incision of the gastric wall is made in front of the base of the tube with the Paquelin cautery, anteriorly and posteriorly, and two mattress sutures, one on top of the other, are placed to further reduce the communication. Completion of operation as usual. Gastrostomy opening corresponds to third costal cartilage.[1]

There is no regurgitation from the stomach. (This procedure, advocated by me some time ago,[2] seems to guard satisfactorily against the peristaltic wave which, ordinarily, would run from the cardia to the pylorus.[3]) Soon a large-sized tube is regularly introduced into the new canal and the food, after being well chewed and then deposited in warm fluid, is pressed into the stomach by means of a large hand-syringe. Patient slowly gaining weight; urgently desires second stage. Therefore, on June 16, thoracotomy and resection of the tumor. Hypodermoclysis of 600 ccm. of Ringer's solution; hypodermic of morphine one-sixth of a gr. plus atropine 1-100. After thorough irrigation, gastrostomy tube removed and wound plugged and covered with adhesive plaster. Intratracheal insufflation (Dr. Eggers); introduction of tracheal tube difficult; patient coughs up quite some blood through the same before operation starts. Torek's incision, left eighth intercostal; ribs divided between angle and spine, with Gigli, up to fourth included; intercostal vessels tied as usual; splendid access with abdominal spreader. Lung not adherent. After opening posterior mediastinum, infiltrating tumor found right behind aortic arch; right pneumogastric nerve can be well pushed off, which is cause of decision in favor of radical operation. No cocainization of nerves on account of the proximity of the aortic arch; latter has to be mobilized; intercostal arteries involved in tumor; profuse hæmorrhage from two, which tear, but fortunately can be tied. Tumor has to be loosened bluntly from beneath arch; very extensive adhesions all around and apparently also to right pleura, which had been opened between arch and diaphragm early in the operation; the posterior adhesions are exceedingly firm, so much so that the advisability of continuing the operation appears questionable. Pulse more rapid and weaker. Increased air-pressure. After some interruption work continued. Suddenly pronounced venous hæmorrhage away down in the depth, evidently from a tear in the vena azygos or one of its branches, close to the trunk. Gauze tamponade. Now circumcision of œsophagus in middle between aortic arch and diaphragm; muscular coat pushed back; fascia tied; chromicized purse-string suture laid; a second circular ligature of œsophagus about one inch above; division with cautery; inversion of lower stump nicely feasible; two Cushing top sutures; stump dropped back; it disappears in the depth. Proximal stump is brought before aortic arch; loosening in upper vault; patient turned on side; typical neck incision; proximal stump pulled out; temporarily wrapped in moist gauze. Incision in tenth intercostal for drainage; closure of chest wound; amputation of œsophageal tumor below ligature; stump pulled underneath skin bridge and fastened; suture of neck wound; dressing. During latter part of operation pulse has become imperceptible at wrist in spite of artificial respiration with increased pressure. Tube removed from trachea; no spontaneous respiration. Artificial respiration applied by means of plus pressure apparatus, but patient has already passed away.

[1] When forming the tube, its middle is found to be rather blue, evidently in consequence of the accidental tearing and necessary ligation of the vessels. During the after-treatment, a number of small fistulæ developed, most likely as a result of the interference with the circulation, all of which goes to show how careful one has to be in handling the stomach in the course of this operation.

[2] Zentralbl. f. Chir., 1914, No. 2.

[3] Syring. Klinisches u. Experimentelles zur Œsophagoplastik. Deutsche Zeitschr. f. Chir., cxxviii, 260.

Although in the following case of intended resection of the œsophagus, the patient died before resection was attempted at the second stage of the operation and the case should therefore not be recorded here, the observations made in the course of the operation nevertheless entitle it to brief mention. It is not counted among the resections.

Carcinoma of œsophagus behind aortic arch; gastrostomy; thoracotomy; first stage of resection as planned at that time, viz., division of œsophagus above cardia; double inversion of either end. Recovery from operation. During interval eversion of inverted proximal stump; perforation of tumor into bronchus; pneumonia; death.

Man, 65 years old; increasing difficulty in swallowing for last eight months. September, 1912, admission to German Hospital; gastrostomy (Kader) by Dr. Torek, who very courteously referred the patient to me for further operating. November 16, at the time of the third Clinical Congress of Surgeons of North America, thoracotomy in negative chamber in the presence of a number of invited guests. In view of the patient's precarious condition the plan was to do a two-stage operation. *Stage 1* to consist in thoracotomy, thorough scanning of the local conditions, dividing of the œsophagus below the tumor, closing of either end by double inversion and strengthening of the proximal end, if possible, by a fascia transplant;[4] drainage. *Stage 2*, second thoracotomy, completion of resection.

[4] Surg., Gynec. & Obst., 1912, xv, 639.

Operation: Incision in eighth intercostal space; lung adherent to diaphragm; œsophagus exposed; tumor well palpable behind aortic arch and tracheal bifurcation; pneumogastrics gently separated and cocainized by placing on them a tampon, saturated with a 10 per cent cocain solution; double ligation of œsophagus about two inches above cardia, with stout silk, division between the ligatures, with cautery; inversion of distal stump, according to method worked out experimentally.[1] This was rather difficult on account of the great depth of the operating field; stump reappears on withdrawing forceps; a few Cushing top sutures placed. Work on proximal stump technically easier; double purse-string and inversion; fascia transplantation not added, in order to save time; closure of thoracic wound after free incision in tenth intercostal space for drainage of pleural cavity; cigarette drain with central rubber drainage tube for bed of œsophagus introduced plus split rubber-tube on either side; zinc ointment, rubber dam; dressing. Patient stood operation nicely; is retained for twenty hours under differential pressure (positive cabinet) in a slight Trendelenburg posture. Free serosanguinolent discharge in dressing. By keeping the patient under differential pressure from the start, after the completion of the operative work, this invariably infected effusion is actually pressed out of the pleural cavity by the continuously inflated lung through the drainage-hole. No special rise of temperature; patient kept in observation room of thoracic department. November 18, forty hours after operation, first change of dressing in chamber; cigarette drain removed, has odor of œsophageal secretion; new dressing with zinc ointment and rubber dam over drainage incision; returned to ward with normal pulse and temperature. November 21, fifth day after operation, second change of dressing; drainage again plentiful; primary union of intercostal incision; patient out of bed. November 26, regular dressings continued; patient gaining, regular feeding through gastric fistula. November 30, on the fourteenth day after operation, ward-nurse reports that dressing became unusually wet during night and on changing it a closed silk ligature was found on the gauze; milk swallowed by mouth soon appears in drainage opening. Evidently doubly inverted proximal stump has become everted, its closing ligature having cut through. Forced feeding through gastric fistula; daily dressings. On seventeenth day after operation, fever set in; cough increased; expectoration of foul odor; distinct signs of pneumonia. Exitus three days later, on twentieth day after operation. Wound inspection shows perforation of the carcinoma into the left bronchus and pneumonia of the left lower lobe; distal end of œsophagus firmly closed; proximal open, everted, imbedded in dense scar tissue.

*Comment.* The case nicely demonstrates how smoothly even such reduced patients can recover from an œsophageal operation, if free drainage of the pleural cavity is used for after-treatment. Had the fascia graft been put on the proximal stump, as contemplated, the eversion might perhaps have been prevented. Animal experimentation has shown the air- and water-tight attachment of the graft to the proximal stump after twenty-four hours. But this could not have prevented the fatal issue. The patient certainly did not die as a result of the œsophageal communication with the pleural cavity, but in consequence of the perforation of the tumor into the bronchial tree. The case further shows that in these advanced cases a two-stage operation should not be recommended. The one-stage operation should be risked, but planned in such a way that it can be broken off at any point and be finished as a palliative or exploratory operation.

[1] Ibid.

The above histories of cases illustrate the progress that is being made in this chapter of operative surgery. They show some of the causes of the accidents that so far, with very few exceptions, have marred our results, and enable us, by the lessons they teach, to guard against their recurrence. We are no longer groping in the dark as to the best mode of procedure and after-treatment in this class of cases. A typical operative method has been evolved which is bound to show improved results, provided only the patients do not come too late.

The improvement in results should be immediate, if careful attention is given to the following points:

1. The selection of cases for radical operation.

2. The removal of the proximal stump of the œsophagus from the posterior mediastinum, and transposition of the same under the skin of the thorax anteriorly and downward.

3. Free drainage of the pleural cavity immediately following operation, in each and every one of the cases.

*Comment ad 1.* Selection of cases for radical operation.

We have been sufficiently conservative in the selection of cases for exploration, but in

proceeding from exploratory to radical work, we have still to learn to be as conservative in thoracic operations as we are in abdominal work.

It is not difficult to understand how the surgeon may be led to be too aggressive after he has once gained entrance to the thoracic cavity. He has done gastrostomy a short time before, possibly connected with inferior œsophagoplasty according to the Beck-Jianu method. He is now anxious to really help the patient and not merely do a palliative operation, although even this would fulfill the most fervent desire of his patient, namely, to regain his ability to swallow. The surgeon is particularly anxious to help this class of patients, as they of all who come under his daily care complain least, are patient and courageous, and give evidence of unbounded, often truly pathetic confidence in his ability to help them. It is hard, then, after all the preparations and preliminary work, to desist and leave the patient to his fate. Yet this should be done more frequently than has been done heretofore. Why should the surgeon act differently in the thoracic than in the abdominal cavity? He would not dream of attacking radically a carcinoma of the pylorus which has encroached upon the pancreas and transverse colon and become firmly attached to the liver. He would either promptly close the abdomen or, in the presence of pyloric obstruction, mercifully put in a Murphy button for gastro-enterostomy. And here, in the thorax, when dealing with firmly adherent tumors behind the aortic arch, at the very Achilles-tendon of life, we have forgotten that there is a limit to surgery; we have moved and removed these tumors when they had infiltrated the œsophagus for three to four inches and more; we have freed them from the surrounding important tissues and organs, pleura, aorta, pneumogastric nerves and bronchus, with knife or scissors, or bluntly—more often the latter—and then we have been surprised and deeply shocked and disappointed to find, when artificial respiration was discontinued at the completion of the work, that the patient had passed away. We have overrated the endurance of our patients in their enfeebled condition. We had no experience to guide us in gauging their power of resistance. But now that we have gained that experience, it is time that a halt be called to radical operation in these far advanced cases, in order that excessive mortality may not further check the proper development of the surgery of carcinoma of the œsophagus.

I should not like to create the impression that we had attempted to extirpate these tumors indiscriminately, that we have operated upon every carcinoma of the œsophagus that has come under our care. Far from it, we have made as careful a selection prior to operation as we knew how. The cases in which we did thoracotomy gave well-grounded hopes, judging from the clinical symptoms, that a radical operation might be successfully done. We erred in not promptly breaking off the operation when conditions revealed *during* operation showed the case too far advanced for radical work.

In the light of the experience had in my cases, I have now made it a rule not to attempt radical work in large, infiltrating tumors of the œsophagus that have grown up from below and behind the aortic arch or have developed directly behind it.

They are inoperable, or rather, for the present, I consider them such. Possibly the future will yet teach us how to deal even with these advanced growths. Maybe we shall learn how to expose freely one or both of the pneumogastric nerves—but gently and sharply, never bluntly!—after mobilization of the aortic arch and properly worked-out cocainization of the nerves, and then work successfully also in this dangerous locality. But for the present it seems wiser to concentrate our energy upon and save the strength and power of endurance of surgeon, assistants, and nurses for the cases that bid fair to respond to our efforts.

If I look at the histories of the eight reported cases of radical excision of a cancerous œsophageal growth from this standpoint, I find but two in which resection was indicated; the remaining six, in all of which the far-advanced tumor was situated partly or entirely behind the aortic arch, should have been considered beyond radical operation.

In the two operable cases—one a man 66, the other one 68 years of age—the operation as such was well borne. One died at the end of the first day, the other one seven days after the operation. In both the thorax was closed without drainage, but for which, I believe, the latter, at least, might have lived, inasmuch as in both the rapidly appearing infected serosanguinolent exudate was the immediate cause of death. In both, the tumor was found between aortic arch and cardia; one of the pneumogastric nerves could be saved in each case; the tube could be easily loosened upward from behind and above the aortic arch.

Summing up, I would say that my experience leads me to advocate radical operation in *any* part of the œsophagus, upon small circumscribed new-growths — usually the rather benign squamous-celled epithelioma—and upon infiltrating carcinomas, excepting of the latter only those situated behind the aortic arch.

Here again comes to view the importance of early diagnosis, followed by prompt operative intervention. But, in order that profession and laity may have the necessary confidence *to seek early relief*, the operative results will have to be improved. The chief factor in accomplishing this must be greater conservatism *during* operation; that is, a more frequent desisting from radical work.

*Comment ad 2.* Removal of the proximal stump of the œsophagus from the posterior mediastinum, and transposition of the same under the skin of the thorax anteriorly and downward.

Because of the anterior situation of the gastrostomy opening, also when employing the method of Beck-Jianu, it appears wiser to loosen the proximal stump in its bed and transpose it *in toto* antethoracically.[1]

Further practical experience *in man* must prove how long this transposed proximal stump may be without becoming necrosed. The peculiar blood supply of the œsophagus may well suffice to keep a longer tube alive, in spite of the severance of its nourishing vessels within its bed. In addition to incomplete blood supply, pressure of the clavicle from below, as demonstrated in my case No. 7, may be a further factor in producing partial gangrene of the more distal portion of the œsophagus in its new position, particularly in emaciated patients. Special attention, therefore, should be directed (1) to making the subcutaneous skin tunnel as wide as possible, avoiding constriction; (2) not to put the stump on the stretch; (3) in case of need, to make a free fat transplantation into the supraclavicular space, to lift the tube and therewith avoid its being kinked at the level of the bone; or (4) to chisel a sufficiently deep groove into the bone to receive the tube.

Zaajer, of Leiden, in his case of successful resection of the cancerous cardia and lower end of the œsophagus, brought the proximal stump out into the intercostal space *laterally*, thus allowing the œsophagus as such to remain *in situ*. But it seems better to have the opening of the proximal stump in front of the thorax, in line with the gastrostomy opening, which is always placed anteriorly.

With œsophagoplasty in view, the Beck-Jianu operation is certainly the ideal procedure of performing gastrostomy, because it combines the establishment of a gastric fistula with the formation of a new œsophagus in its lower half, if not its lower two-thirds: "inferior œsophagoplasty."

The Beck-Jianu operation is still on trial. To make it the operation of choice, a number of important points regarding it require further investigation. I would mention only (1) the persistence of the peristaltic wave in the new tube, viz., from the cardia upward to the new gastrostomy opening which latter usually corresponds to the level of the left third or even second rib; (2) the likelihood of the interference of the gastric secretion discharging from the tube-opening, with plastic skin work, that may become necessary for the completing of the new antethoracic œsophagus.

In order to avoid the upward peristalsis in the Beck-Jianu tube, I have proposed:[2]

(*a*) A transverse superficial cauterization with the Paquelin anteriorly and posteriorly, in front of the base of the tube, to destroy

[1] J. Am. M. Ass., 1914, January 10, Figs. 21 and 22.

[2] Zentralbl. f. Chir., 1914, No. 2.

the nerve supply. It remains to be seen whether this will do harm with reference to the nutrition of the tube.

(*b*) To make the communicating opening of the tube with the cardiac portion of the stomach as small as possible, by converging the incision toward the major curvature.

(*c*) To place, after completion of the second row of sutures, a widely approximating additional mattress suture at this spot, if necessary, in *double layer*.

(*d*) To make a slight twist of the tube, according to Gersuny's method.

Recently I had opportunity to test *a*, *b*, and *c* in three cases, and the functional result was more satisfactory.

Personally, I have done the Beck-Jianu operation six times without losing a patient.[1] It certainly is a very fascinating procedure, but is justified only—be this emphasized once more—with reference to a possible future anterior transposition of the oral stump of the œsophagus—this being the "superior" —and the Beck-Jianu operation the inferior partial œsophagoplasty — after resection of the intrathoracic tumor.[2] Otherwise the watertight gastric fistulæ resulting from the older and simpler methods of Witzel, Kader, and Senn are decidedly preferable.[3]

In five of the six cases Hültl's wire-stitching instrument was used for the first row of sutures, with great satisfaction. It renders the operation absolutely dry and aseptic and shortens its duration. It would be gratifying if an American instrument of similar type were constructed in the near future. Of course, the surgeon should not rely on the use of this instrument only; he should practice the operation also with needle and thread and two clamps of equal size, their curve corresponding to that of the major curvature.

For sewing material chromicized gut will most likely be the best, at least for the second (outside) row of continuous sutures, in view of any possible suppuration at either end of the subcutaneous tunnel. In my first case of this kind (see above No. 5) the continuous silk suture gave us a good deal of trouble on account of the submuscular suppuration.

Ach[4] and Rehn Jr.[5] have of late practiced resection of the œsophageal tumor by way of the posterior mediastinum, thus avoiding entrance into the pleural cavity. It is to be hoped that both will continue this work, so that comparisons may be made between the results obtained with their method of advance and the transpleural resection with subsequent drainage, as practiced by us.

*Comment ad 3.* The necessity of drainage of the thoracic cavity after each and every case of œsophageal operation.

I had come to this conclusion by adverse experience two years ago, when I had hermetically closed the chest in one of my cases of resection and lost the patient in consequence of a rapidly appearing pleural exudate.[6] The observation of Torek's beautiful case of successful resection of the thoracic portion of the œsophagus, *without* drainage of the pleural cavity, made me waver. It seemed to confirm Sauerbruch's procedure, who always closes the thorax airtight (Technik der Thoraxchirurgie, 1911). However, my experience has convinced me that Torek has here been favored by a remarkable amount of luck. Had I drained the pleural cavity in my patient (Case 7), the German Hospital of New York would now most likely have to its credit two recoveries after resection of the œsophagus in its thoracic portion. I started the operation with the intention of draining the cavity, but changed

[1] The sixth operation, done on a patient of 27 years for cancerous stricture of the œsophagus on November 20, also made a smooth recovery. Propositions *a*, *b*, and *c* were again carried out. There is no regurgitation. I shall now try out whether proposition *a* cannot be omitted.

[2] If the Beck-Jianu operation should prove to be a useful procedure also as to its final functional result, it would no longer be necessary to perform the complicated though very ingenious Roux-Lexer method which, as is known, consists in the subcutaneous transposition of a doubly excluded jejunal coil plus skinplasty nor the Kelling-Vulliet method, which makes use of the totally excluded and transposed transverse colon.

[3] In this connection I would mention an observation which I have repeatedly made with Kader's method. While usually its functional results are splendid, when the stenosing tumor occupies about the *middle* portion of the œsophagus, I have seen dire results follow in cases in which an infiltrating cancer was located *in the lower end of the œsophagus and the cardia*. Here the double layer of silk sutures used for the formation of the fistula sometimes cut through giving rise to a large hole in the gastric wall, to which the patient quickly succumbs. I believe that involvement of both pneumogastrics is most likely the cause of this leakage, same as this is observed in transverse division of the stomach near the cardia, with gastrostomy done at the same sitting. Therefore, it seems that in this class of carcinomatous strictures Witzel's or Senn's method is preferable.

[4] Beiträge zur Œsophaguschirurgie, 1913.

[5] Œsophaguschirurgie, Jena. 1914.

[6] Surg., Gynec. & Obst., 1912, xv, 639, Case 2.

my plan when I saw how well the lungs of the patient could be distended, and because no aseptic mistake had occurred during the operation. But when, at the wound inspection, after the death of my patient, which had occurred under the mildest general clinical symptoms on the seventh day after the operation I saw the havoc wrought in the chest and posterior mediastinum by the retained infected exudate, my formerly tentatively expressed belief, based on practical experience (*loc. cit.*), became an absolute conviction. I therefore say that it is our duty *to drain the thorax* immediately after the operation in all cases of resection of the œsophagus for carcinoma. It is not wise to close it air- and water-tight.

The method by which drainage can be easily done, by employing a differential pressure apparatus— cabinet or chamber—for overcoming the danger of a post-operative acute pneumothorax, has been dwelt upon in a former article.[1] Only if the surgeon lacks the proper facilities for drainage, is he justified in closing the thorax; but in that event he will have to keep a careful lookout for the possible advent of a pleural exudate. While a sudden post-operative rise of temperature is suspicious, it may of course be due to various other causes; e.g., a developing bronchitis or pneumonia. More suspicious for an exudate, as a corroborating clinical symptom, is dullness on percussion over the lower portion of the side of the thorax operated upon, and reduction of vocal fremitus. In the presence of the latter aspiration should be done *immediately*, even if the general clinical symptoms are favorable. In case a clear yellowish fluid is found, as in ordinary pleurisy, serological examination may decide whether drainage is required; for a sterile exudate can, of course, be left for absorption. However, this will rarely be the case, and for practical purposes it is best to consider as infected any exudate in a closed pleural cavity occurring after œsophageal resection. In the large majority of cases the needle will show an accumulation of serosanguinolent fluid, which is to be considered one of the most formidable factors in frustrating a successful issue. In that event free drainage has to be established *on the spot*, either by means of resection of a rib, as in empyema, or by means of a new intercostal opening, rather than by reopening part of the thoracic incision. It is possible that in this way patients may still pull through under careful nursing and treatment, but it is a risk that had better be avoided. Personally, I feel that immediate drainage of the pleural cavity after intrathoracic resection of the œsophagus for carcinoma will improve the prognosis of this operation.

[1] Ann. Surg., Phila., 1912, July.

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## PLASTIC OPERATIONS ON THE STOMACH

### An Experimental Study

By CARL BECK, M.D., Chicago

PLASTIC surgical operations upon the stomach have not been tried extensively, although anatomic and histologic conditions are inviting. The circulation and anatomic arrangement of the material are favorable, and the healing process is very good.

I was first attracted by this field in 1904, when Dr. Alexis Carrel was associated with me in our experimental work on animals. We developed the idea to form an œsophagus from the stomach by a plastic method. Though our results were not ideal, owing to restricted facilities of our laboratory, we succeeded well enough to obtain good surgical results. We called the operation the formation of a prethoracic œsophagus and demonstrated our specimens at the meeting of the

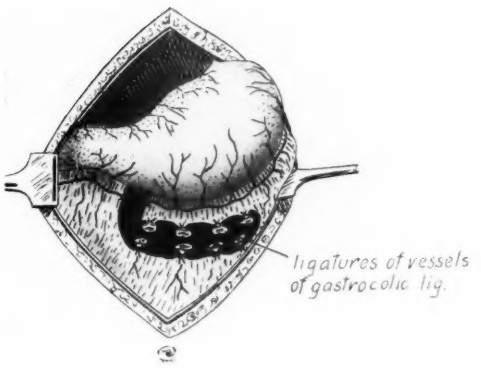


Fig. 1.

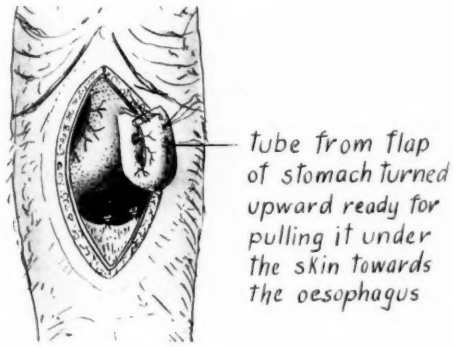


Fig. 3.

Chicago Medical Society.[1] The procedure carried out on the dog was briefly as follows:

Laparotomy by median incision in upper abdomen, stomach brought out of abdomen, clamped by long hæmostatic forceps; gastrocolic ligament ligated at several places so as to free the border of the large curvature of the stomach; inferior coronary artery ligated near the pylorus on the spot where the plastic flap is to begin. Now the tongue-shaped flap with the coronary artery in the center is cut long and broad enough to allow the formation of a tube similar in width to an œsophagus. The stomach and tube are sutured exactly; the free end of the tube is now drawn upon the anterior surface of the chest through a slit in the wall above the incision in such a manner that it passes the tunneled skin of the chest-wall and its orifice appears upon the surface about midway between xiphoid and jugulum (Figs. 1 to 3).

The second step is to form the upper tube from the œsophagus proper. A right lateral

[1] Illinois M. J., 1905.

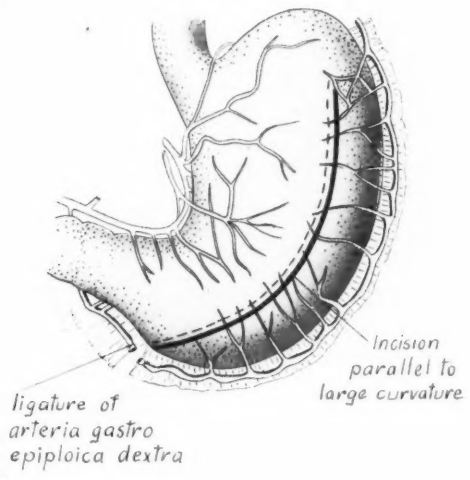


Fig. 2.

Fig. 4.

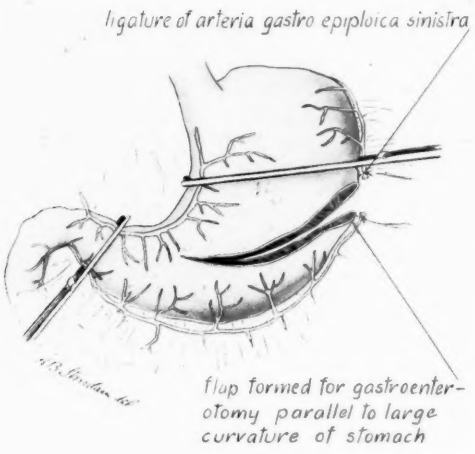
ligature of arteria gastro epiploica sinistra
flap formed for gastroenterotomy parallel to large curvature of stomach

Fig. 5.

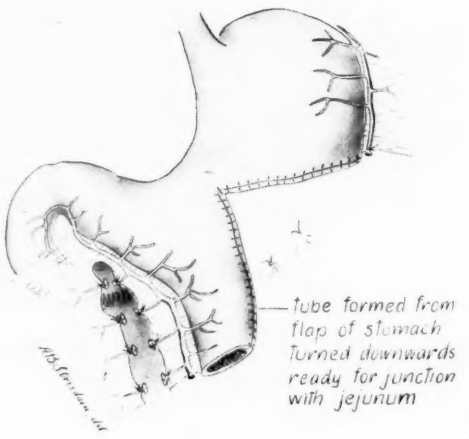


Fig. 6.

incision of the neck allows exposure of the œsophagus, which is hooked upon the finger and drawn outward as far as possible; the distal part is ligated and dropped back, the proximal part passed underneath the skin of the chest through a tunnel to the same spot from which the stomach tube issued; the two orifices are now united end-to-end. Thus a continuous tube is formed from the pharynx to the stomach, running in front of the chest-wall—a prethoracic œsophagus.

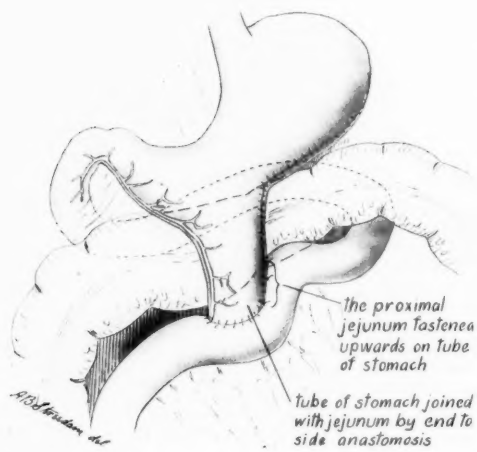
the proximal jejunum fastened upwards on tube of stomach
tube of stomach joined with jejunum by end to side anastomosis

Fig. 7.

Our surgical results, as I said before, were good. Shortly after our demonstration Dr. Carrel left for New York, and I did not continue the experiments for some time. They were inspired by the idea of giving the poor sufferer of a relatively slow growing obstruction of the œsophagus a better relief than can be obtained with obnoxious gastrostomy.

Our experiments were published in the *Illinois Medical Journal* in 1905, but unfortunately did not find their way into the broad stream of literature, so that it remained for a European experimenter to revive them in the *Deutsche Zeitschrift für Chirurgie* four years later, and the method became known as the Jianu operation. It has since been performed successfully on the human, once also by Willy Meyer, of New York, who read a paper in Minneapolis on this subject. Naturally, the operation will be very seldom performed since the indication is a rare one. However, in those cases of extensive and otherwise intractable strictures resulting from corrosions of the œsophagus or cardia by acid or alkali, it might offer good and permanent relief.

During the past year I took up again the thread of experiments in that field, this time

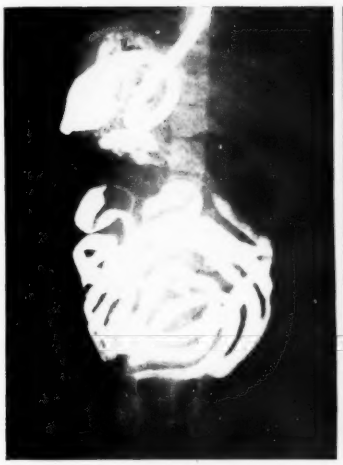

Fig. 8 (at left). X-ray picture of dog with stomach tube which is filled with bismuth passed into his stomach.

Fig. 9. X-ray picture of dog six minutes after the food with bismuth had been taken.

Fig. 10. X-ray picture of stomach with new pylorus (A) filled with bismuth. Post-mortem.

aroused by some of the shortcomings of our present methods of dealing with some of the surgical conditions of the stomach. Cancer and ulcer still dominate surgery of the stomach, and gastro-enterostomy has sway over all of the methods of treatment. This is easily understood, as it affords relief in many cases, cures a great number of ulcers, and is easily performed. All this makes the operation a favored one. But if we control it through fluoroscopy and observation of post-operative results years after gastro-enterostomy, we can conclude that we have by no means definitely solved the problem how to treat an ulcer of the stomach or duodenum. Without going into detail or making suggestions, I am going to relate the results of some experiments done during the past year relating to this subject.

I must give to my assistant and associate, Dr. W. C. Jones, credit for the painstaking operations and for recording the results during these experiments. Most of the dogs were operated by him after I did the first experiment, and thus the results were controlled.

*First series.* The plastic formation of a new pylorus by a flap.

Method: Upper laparotomy; the stomach is brought out clamped temporarily below pylorus and near cardia transversely; gastrocolic ligament ligated (Fig. 4); coronary artery ligated; tongue-shaped flap cut with base towards pylorus (Fig. 5), and sutured to a tube (Fig. 6). The tube is inserted into jejunum in such manner that the proxima part of the jejunum is fastened alongside this tube so as to avert the vicious circle (Fig. 7). Wolfler and Hartman advocate a similar step in anterior gastro-enterostomy. A large number of dogs were operated upon, but only one history follows:

Operation: Same as performed on Dog 1, except clamp was used. (Method same as described above.) Description of dog: Small mongrel, white, with yellow spots on hinder portion of body; black eyes; male. Place, 2362 North Clark Street; operator, Dr. W. C. Jones; assistant, none; anæsthetist, Dr. Harz; anæsthetic, A. C. E. mixture; date, March 13, 1914. Remarks: Operation uneventful, though worked at disadvantage on account of having no assistant.

Results: March 20, 1914, dog in fine condition. Dr. Harz assures me that it has been in excellent shape ever since the operation. Wound in skin very slightly infected, and the linen has not been entirely licked away, dog is lively and playful. March 27, 1914, dog continues in excellent condition. April 3, 1914, dog perfectly normal in every way. April 29, 1914, dog perfectly normal in every way. May 6, 1914, dog in fine condition. Laparotomy. Produced complete ob-

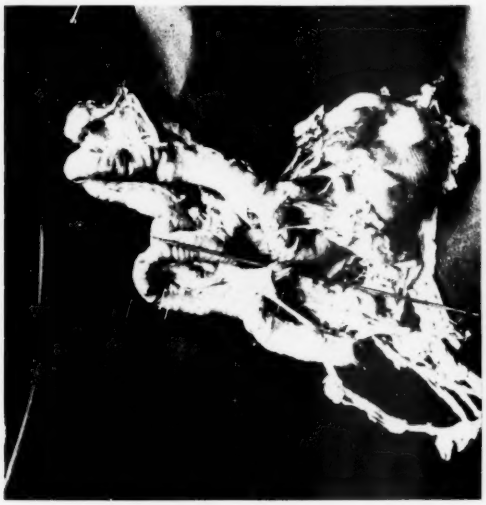

Fig. 11. Duodenum implanted into pyloric end of stomach. Probe indicates circulation of implant.

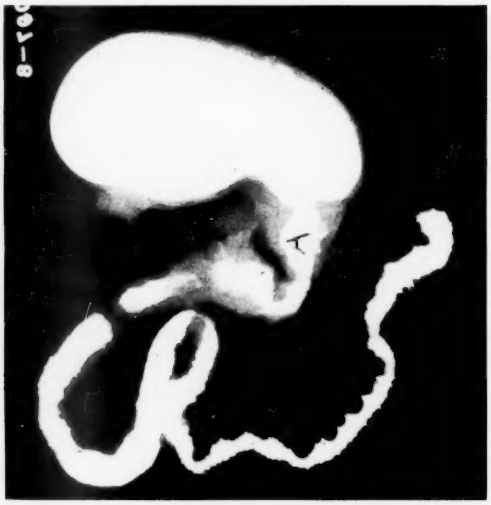

Fig. 12. X-ray picture of stomach with implanted pylorus (A) filled with bismuth. Post-mortem.

struction about three-fourths inch distal to pylorus by cutting clear through gut and enfolding ends. Pylorus was entirely unobstructed, there being no apparent evidence of the former ligature. The new gastro-enterostomy opening was entirely patulous, the opening being apparently three-fourths inch or more long. This fact was ascertained by passing a curved forceps through the pylorus and down the new gastro-enterostomy tube into the duodenum. June 3, 1914, dog killed today, and stomach and duodenum removed with the intention of taking an X-ray picture after filling with bismuth. Animal in excellent condition before death and had been ever since last operation. Opening from new tube into duodenum large and apparently functionating as well as the natural pyloric outlet.

The results operatively were good. What made these experiments more interesting was the control examination with the fluoroscope done by Dr. Paul Eisen at the North Chicago Hospital. A stomach-tube was inserted into the stomach and filled with bismuth. The picture shows that it is impossible for the tube to pass through the new stoma, but shows that the stomach and new pylorus have a good physiologic function (Fig. 8). Also a number of X-ray pictures taken from such dogs show that the new pylorus is working perfectly (Fig. 9). A number of pictures of the specimens removed from such dogs filled with bismuth give an exact idea of the structure of such a stomach some months after operation (Fig. 10). This tube has no tendency to contract, as it is working with its muscular apparatus.

We operated upon some of those dogs a second time and cut the pylorus in the manner of von Eiselsberg and found the new pylorus after this operation perfectly patulous.

*Second series.* Implantation of the small intestine in place of resected pylorus.

Method: Upper laparotomy; stomach lifted out; a tube about three inches long of the small intestine cut out of its continuity but left in contact with its circulation; the pylorus resected to the extent of three inches and the intestinal tube implanted into this gap by end-to-end union (Fig. 11). A number of dogs were operated upon, but only one history follows—that of the fourth dog. A number died shortly after the operation, but when the technique was perfected most of them lived.

Operation: Same as on previous ones. Three inches of jejunum with preserved circulation implanted into gap of excised pylorus. Description of dog: Jocko II. Yellow and white male. Place, 2362 N. Clark St.; assistant, Dr. Melnikoff;

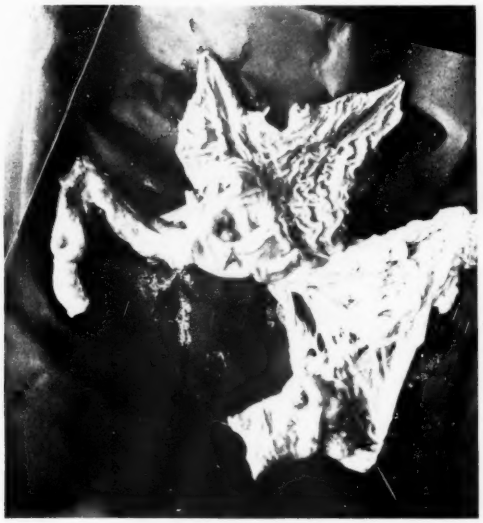

Fig. 13. Patch (A) in small curvature.

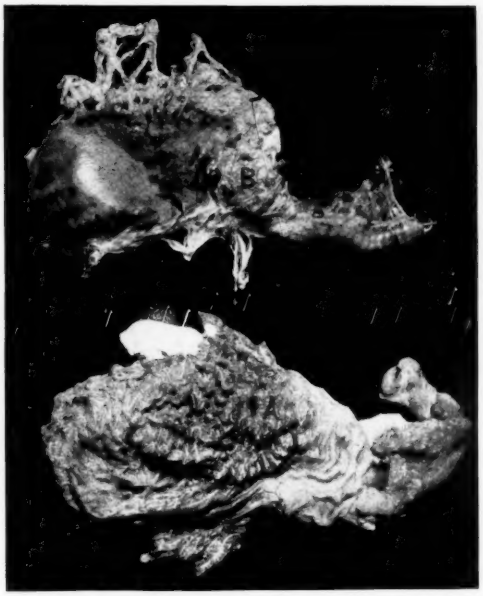

Fig. 14. Upper picture. Defect covered with omentum (B). Lower picture. Stomach open showing the defect (A).

anæsthetist, Dr. Harz; anæsthetic, ether. Date, July 27, 1914. Remarks: August 14, 1914, some vomiting; general condition fair, dog playful. The dog was killed later by Dr. Beck.

The fluoroscopic examination proved the absolutely good function of the implanted intestine and the examination of the specimen of the dog killed after weeks showed remarkable changes in epithelial structure, the epithelium of the jejunum growing similar to that of the stomach. There was the tendency of the mucosa epithelium to draw out into tubules close to the scar. Lack of time and facilities prevented the physiologic experimentation upon these structures which may yet be done, but the picture of the specimen shows the exact union and the X-ray the correct form of the stomach (Fig. 12).

*Third series.* The use of an intestinal patch for the stomach defect in the small curvature. This experiment was inspired by the difficulty of dealing with the stomach after resection of a portion of the small curvature in a case of ulcer of this region.

Method: A tube of the small intestine was cut three inches long, the circulation carefully preserved, the tube transformed into a rectangular flap by cutting it in its periphery. Then a defect similar in shape and size was made by cutting out a portion of the small curvature of the stomach; then the patch of the small intestine was fitted by exact stitches into the defect of the stomach. The defect healed beautifully and the dogs did well. No difficulty was seen except that the specimen showed that the patch retracted considerably (Fig. 13). This led to a fourth series of experiments which showed me a remarkable quality of the stomach, at least, in the dog, and explained to me many pathologic conditions which I did not fully appreciate before.

*Fourth series.* Resection of large part of the front wall of the stomach and filling of the defect with omentum only, without stitching the wall.

Method: A piece of the stomach wall two to two and one-half inches in diameter was cut out sharply, the large omentum placed over the defect and fastened to the border of the defect with four single interrupted stitches. We were surprised that

all the dogs survived and were doing well. Even a few days after the operation they were lively and ate well and the examination after even as short a time as one week, surely after five to six weeks, showed that the defect had dwindled to a small point and the omentum covered it up on the outside, forming a defense wall against perforation (Fig. 14). This remarkable fact proved to us the possibility of rapid healing of an ulcer if omentum is present on the outside and the wonderful retraction of a defect. If we take into consideration the muscular apparatus, the histologic arrangement of the muscle-fibers and the elastic fibers, we understand these facts better. At the same time, however, it explains to us the tendency of the gastro-enterostomy to close up or to retract, as the conditions in both instances are precisely the same. The stoma of the gastro-enterostomy becomes smaller and smaller and ultimately all the food passes through the old pylorus, as can be proved by the use of the fluoroscope. What will happen in these cases after two, or three, or four years, if we cut the pylorus or obstruct it permanently, remains to be seen.

Incidentally I may mention that fascia in in this series did not give the same result. The dog died promptly the second day.

*Fifth series.* Excisions of portions of the stomach and implantation of neighboring flaps of the stomach, according to the well-known laws of plastic flaps.

Needless to say, these experiments were all satisfactory and showed to us the possibility of replacing portions necessary after resection of ulcers of the stomach. A great vista opened itself to us with the possibility of a number of other variations which are now under observation and study in the splendid material of the stomach.

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## A STUDY OF TWENTY-FIVE TABETIC BLADDERS[1]

By IRVIN S. KOLL B.S., M.D., Chicago
Professor of Genito-Urinary Diseases, Post Graduate Medical School; Associate Genito-Urinary Surgeon, Michael Reese Hospital; Director, Genito-Urinary Department, West Side Jewish Dispensary

A PREVIOUS report of a bladder picture which seemed to be typical of spinal cord changes associated with locomotor ataxia has subsequently been verified by observing twenty-five additional cases. In seven of these the diagnosis was made from the vesical findings before there was any suspicion of a nerve lesion.

The bladder changes as described and illustrated in my previous paper consist, primarily, of an unusual trabecular formation, characterized by a lateral grouping. The area occupied by the so-called interureteric ligament remained practically free. These trabeculæ are fibrillary and closely resemble the papillary muscles of the heart. This fibrillary character and general arrangement differentiates them from the trabeculæ of obstruction when they are much coarser and are equally distributed throughout the trigone and occasionally well up toward the vertex. The interureteric area stands out very prominently and seems to form a line of demarcation between the trigone and the vertex. The blood-vessels along this line are increased in size and number.

The other appearance which was present in twenty of the cases is what I have termed a rigid ureteral orifice — a condition similar to the Argyll Robertson pupil. The rhythmic orificial contraction is either sluggish or absent. Instead of the contraction noted with each extrusion of urine, the orifice appears partially or widely gaping. This was more frequently noted to be bilateral, but also was in five instances unilateral. In all of the twenty-five cases a positive Wassermann was obtained and subsequent examinations by a neurologist showed distinct spinal cord changes.

Arbitrarily, I have divided the cases into three classes:

[1]Read at the Annual Meeting of the American Urological Association, Philadelphia, June 18, 1914.

1. Those with vesical symptoms without subjective nerve changes.
2. Those with vesical symptoms with subjective nerve changes.
3. Those whose symptoms pointed toward renal involvement.

Three of the histories, briefly cited, will illustrate each of these classifications.

CASE 1. Male, age forty; referred by physician, who had made a diagnosis of cystitis. Cystoscopic examination showed the bladder picture described above. Diagnosis of chronic prostatitis and urethritis in the presence of a tabetic bladder was made, the latter condition verified by a positive Wassermann. Three intravenous injections of neosalvarsan completely relieved the subjective symptoms, though the bladder remained unchanged in appearance. The patient has since developed an Argyll Robertson pupil, and has had some lightning pains of the arms and legs.

CASE 2. Male, age forty-three; referred by an ophthalmologist, whom the patient consulted on account of recent difficulty in reading, and also because of having difficulty in emptying his bladder. Both eyes gave the Argyll Robertson reaction; urine perfectly clear; prostate normal; cystoscopic findings, those of a tabetic bladder. Wassermann positive and his bladder symptoms have completely disappeared under antiluetic treatment.

CASE 3. Female, age thirty-eight; had severe attacks of what was typical of a renal colic. Skiagraph negative; urine contained no blood or pus; cystoscopic examination showed typical lateral trabeculæ, and both ureteral orifices widely gaping; mucous membrane not inflamed. Wassermann positive; no history of lues was obtainable; no demonstrable nerve lesions. Symptoms have disappeared following four injections of neosalvarsan.

Illustration which shows the exact findings as described.

The interpretation to be placed upon this type of bladder changes is not known. Without doubt there are various sets of nerves, some of which are involved in the sclerotic changes in the attack upon the cord by the spirochæta, while other nerve-bundles apparently remain free, as is evident by the fact that the central portion of the base of the organ remains normal.

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# INTUSSUSCEPTION

## NEW POINTS IN THE ETIOLOGY AND A NEW OPERATION FOR THE PREVENTION OF ILEOCÆCAL REINVAGINATION

BY WILLIAM R. CUBBINS, B.S., M.D., CHICAGO
Assistant Professor of Surgery, Northwestern University Medical School; Associate Surgeon, Cook County Hospital

THE etiology of intussusception is very obscure. It occurs most frequently before the seventh year; sex, race, previous diseases, general nutrition or activities seeming to bear no relation to its onset. Cathartics, coarse food, and pedunculated tumors of the bowel lining favor intussusception, but there is no absolute cause which leads directly to this condition.

In my cases of intussusception the anatomical condition that has attracted my attention the most is the length of the mesentery of the terminal ileum and the fact that the descending colon in these cases also possesses a distinct mesentery. These mesenteries were from two and one-half to three and one-half inches long (see Fig. 1). The mesentery of the terminal ileum in the adult is from two to

Fig. 1. Shows the long mesentery to terminal ileum and a mesocolon.

Fig. 2. The ileum is shown sutured parallel to the ascending colon. It is to be remembered that as a rule this bowel, due to the long mesentery, falls horizontal in the belly.

three inches long, and the ascending colon in the majority of individuals has no mesentery at all. It is easy to see how long these mesenteries must be when one considers how far the intussuscepted bowel can migrate. Whether these mesenteries are stretched during the intussusception or are an etiologic factor will be difficult to prove, but there seems to be a distinct relation between the two.

As we know that any constriction of the bowel which blocks the return circulation will tend to make the bowel soft and œdematous, thus reducing its tensile strength, it seems to me that this condition should never be reduced by distending the colon with fluid, either before or after a laparotomy. Operation should be performed as soon as the diagnosis is made. An incision four inches long to the right of the umbilicus is satisfactory and aids rapid work. The intussuscepted mass is found and, after covering with a gauze sponge, is milked gently, one hand following the other, until the intussusception snaps out. In this way it is not necessary to draw upon the weakened bowel. This method has served me in cases of 96 hours' standing and in one with multiple intussusceptions.

In early cases there is a tendency for the intussusception to recur and, in order to avoid this accident, I have used the following method (see Fig. 2):

The ileum is brought parallel to the ascending colon and sutured to it with three to five catgut sutures. The cæcum is fixed in the iliac fossa in some cases with another suture. The fact that as the two bowels are parallel and cannot intussuscept will be at once evident. The long mesentery of these bowels allows them to assume a horizontal position in the belly, and we therefore need not consider a kinking of the ileum.

# FRACTURE OF THE SPINE OF THE TIBIA

By JOSEPH J. KURLANDER, M.D., Cleveland, Ohio
Associate Orthopedic Surgeon and Röntgenologist to the East Side Free Dispensary

FRACTURE of the spine of the tibia is a rare type of intracapsular fracture of the knee-joint. Often associated with this injury there is found rupture of either one or both crucial ligaments. Investigation has shown that rupture of the crucial ligament may exist without fracture of the tibial spine, or fracture of the spine of the tibia may exist without rupture of the crucial ligaments.

Hogarth Pringle published a report (1907) on a case of rupture of the crucial ligaments with avulsion of the tibial spine. In this case he sutured the spine back into position. This is the first recorded operation for this type of injury. In 1888 Sir Rickman Godlee described the lesion that he had found in a leg that was amputated by Erichson in 1873. The injury in this instance had been caused by the passage of a cart-wheel over the leg.

Briefly, I will describe the anatomy of the superior articular surface of the tibia. On the upper surface of the tibia two articular facets extend upward in the middle of the joint, forming the two tubercles of the spine of the tibia. Along the summit of the spine runs a groove anteroposteriorly. This groove opens up at the anterior and posterior ends into the V-shaped intercondyloid fossæ. The anterior V-shaped intercondyloid fossa furnishes attachment to the anterior portion of the semilunar cartilage and for the anterior crucial ligament. The posterior fossa offers attachment to the posterior horn of the semilunar cartilage and the posterior crucial ligament. Thus the anterior crucial ligament passes from the inner tubercle of the spine upward, backward, and outward and is inserted into the inner aspect of the external condyle of the femur. The posterior crucial ligament passes upward, forward, and inward to be attached to the interior portion of the internal condyle. It lies behind the anterior crucial ligament.

It follows therefore that —

1. When the knee is fully extended, the anterior crucial ligament is tense and prevents displacement of the tibia forward on the femur.

2. When the knee is fully flexed, the posterior crucial ligament is tense and prevents backward displacement of the tibia on the femur.

3. Both ligaments prohibit inward rotation of the tibia.

Bearing these points in mind, one may diagnose an injury of the crucial ligaments quite readily; e. g., if in the extended position the tibia cannot be displaced forward, it may be assumed that the anterior ligament is intact. If in full flexion the tibia cannot be displaced backward, the posterior ligament may be presumed to be intact. The most constant sign of fracture of the spine of the tibia is an obstruction to full extension of the leg.

Avulsion of the tibial spine is practically always produced by violent traction on the crucial ligaments. It seems logical, therefore, to assume that extreme violence is necessary to rupture the crucial ligaments. Such violence would in all probability produce complete dislocation of the knee-joint.

I wish to report the following case:

J. H., male, age 19, was seen in the fall of 1913. He gave the following history: Three weeks previous he jumped off a wagon and in landing on the ground his leg suddenly flexed and he struck his knee on the curbstone. He tried to arise, but could not fully extend the leg nor stand upon it because of severe pain. He was removed to a hospital and the leg was placed in a splint.

The leg became greatly swollen and painful and two X-ray pictures were taken and said to be normal. At the end of six days he was discharged from the hospital as cured. Pain and stiffness persisted, and he was referred to the East Side Free Dispensary for diagnosis. The leg was painful and swollen and free fluid could be made out in the joint.

A radiograph was taken (Fig. 1) showing a complete transverse fracture of the spine of the tibia. A plaster cast was applied with the leg in full extension and allowed to remain for six weeks. It was then removed and active and passive motion inaugurated. He made a complete recovery with normal function.

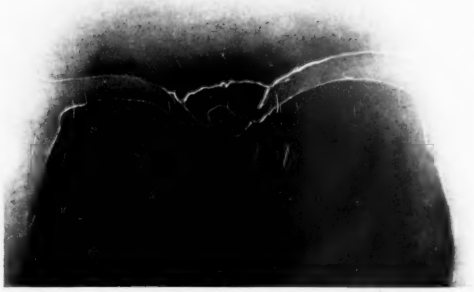


Fig. 1. Transverse fracture of spine of tibia. Negative retouched.

I also wish to take the liberty of mentioning several cases that came under the observation of Robert Jones of Liverpool and S. Alwyn Smith[1] of Winnipeg from whose paper I have drawn freely.

CASE 1. A young lady fell on a piece of wood and struck her knee at a right angle. When she started to walk she suffered great pain and was unable to extend her leg fully. She walked upon it for a year, her knee having become more flexed. She was operated upon — an exploration of the knee-joint — in another city, but it resulted in increased lameness and stiffness.

On being consulted two years after the accident there was found to be only 20 degrees of movement in the knee-joint which could not be fully extended. There were marked tenderness over the head of the tibia at each side of the ligamentum patellæ. There remained slight anteroposterior movement of the tibia on the femur. Pain was acute on any attempt at complete extension. Fracture of the spine of the tibia was diagnosed and confirmed by radiograph.

CASE 2. A farm laborer was run over by a wagon. The wheels passed over both knees. He does not remember the exact position of the limbs at the time. The right knee became swollen at times and full extension is impossible. This movement is limited by 15 degrees, although full flexion is painless. There is tenderness over both lateral ligaments.

The X-ray shows that the external tubercle of the spine is fractured and displaced inward. The knee was forcibly extended under anæsthesia and fixed for two weeks in this position. Massage and motion were gradually employed, with the result that there is a distinct improvement in the range of motion.

*Rupture of crucial ligaments.* Patient had complete backward dislocation of the tibia into the popliteal space. The knee was reduced and was quite flail. The leg was put up in plaster of Paris in full extension for six months, and the result was a perfect restoration of function. He was last seen running up a rocky slope, jumping from rock to rock.

This case answers the question whether or not it is best to operate on recently ruptured crucials. It seems unwise to operate without trying first immobilization in complete extension.

*Treatment.* The treatment of fracture of the spine of the tibia should be non-operative when seen early. The leg should be put up in full extension in plaster of Paris for six weeks to two months, after which good function of the knee-joint may be confidently expected, providing, however, that the fragment is not lodged into the joint so as to block full extension.

When full extension is not possible and in addition there exists disability, whether it be pain, stiffness, or effusion, operation is to be recommended.

*Technique.* To obtain a good view of the interior of the knee-joint and to simplify the operation, the leg should hang over the table with the knee flexed at a right angle. A vertical incision is made through the center of the patella, extending from one inch above it to the tubercle of the tibia. The patella is sawed vertically and its ligament split. The segments of the patella are separated to the border of the condyles. The fat behind the patella is removed. An excellent view of the spine and anterior crucial ligament is thus obtained. Any obstructive mass is removed and the knee straightened.

If the crucial ligaments are found ruptured they may be sutured. The ligament of the patella, the aponeurosis, and the quadriceps tendon are sutured. It is not necessary to wire the patella. The leg is then immobilized for six weeks, after which the dressings are removed and motion commenced.

[1] Rupture of the Crucial Ligaments of the Knee, and Fractures of the Spine of the Tibia. Brit. J. Surg., 1913, i. No. 1

# THE TEMPERATURE RANGE AFTER SUPRAVAGINAL HYSTERECTOMY FOR MYOFIBROMATA[1]

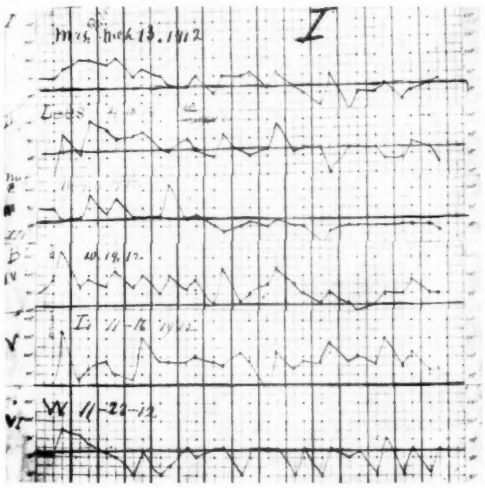
By I. S. STONE, M.D., Washington, D. C.

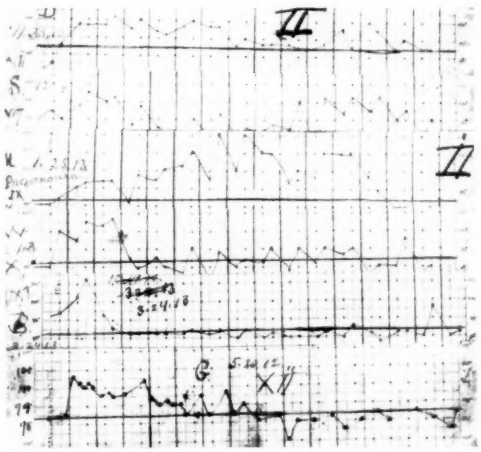
WHEN is the temperature normal? When does it indicate morbidity? Since the introduction of iodine as an antiseptic the writer has used it in an attempt to obtain absolutely perfect results in the operations upon uterine myofibromata.[2] It is unnecessary to say that many reasons may be given for failure to obtain an absolutely straight line temperature chart after hysterectomy. In most instances, there is an elevation of temperature during the first three days after operation, which is due to trauma and not to infection. The writer has found in his own work that almost all the morbidity after hysterectomy is a result of infection about the stump, or under the flap of peritoneum near the stump. When patients have infection here it is not a matter of surprise that deep-seated pelvic phlebitis may follow and that sudden and even fatal complications such as are due to thrombosis and embolism may occur.

The careful examination, during the period of convalescence, of all patients subjected to supravaginal hysterectomy will disclose some interesting and important local conditions not generally appreciated. One of these is the formation of hæmatomata. Such a complication may and probably does occur most frequently in the space previously occupied by an intraligamentary tumor. That an effusion of blood or serum may and does collect under the peritoneal reflexure of the bladder near or over the stump, I have found on more than one occasion.

Another result of hysterectomy with unilateral oöphorectomy is that the remaining ovary is often greatly swollen. An examination has shown this in a majority of instances. Obviously this is due to interference with the circulation in the organ. Such ovaries as a rule return to their former size but may not do so if infection occurs, and, in any event, they often appear to resemble the typically cystic ovary when inspected some months after operation.

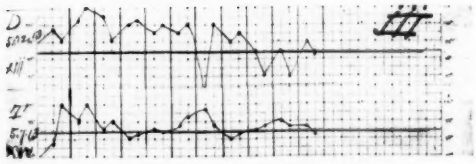
The formation of hæmatomata and the swelling (congestion) of the ovary doubtless influence the temperature curve, although suppuration may not occur. These patients, as a rule, make good recoveries, although the convalescence has not been perfectly satisfactory, as many charts will show.



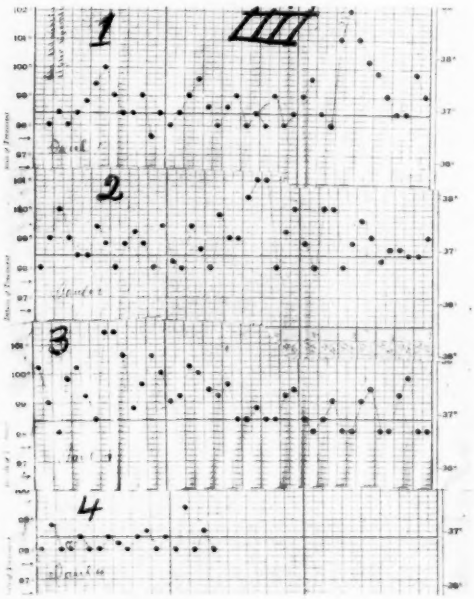


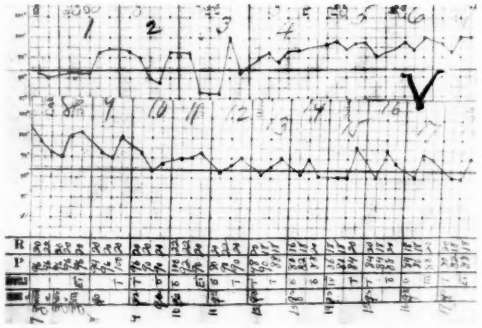
[1] Read before the American Gynecological Society, May, 1914.

[2] The method of introducing iodine into the uterine canal has been described elsewhere.



Finally, in view of the variations in the temperature curve, we are led to ask, What is the normal or standard temperature range in supravaginal hysterectomy? Comparatively few of our charts show a normal range of temperature. Some are subnormal as here shown, yet the condition of the patient at no time was suggestive of the least departure from the normal or typically favorable convalescence. In view of the great diversity of opinion regarding a normal chart we have brought these results to your attention and believe that the use of iodine as proposed has proved a valuable aid in securing a better, if not a normal, convalescence after supravaginal hysterectomy. Our experience with the method has extended over three years, during which time we have secured perfect asepsis of the field of operation. The temperature range as shown in these charts is not greatly improved, by the addition of iodine injections, over the results of the former method, but we claim greater precision of technique, and feel assured that it is possible in this way to entirely eliminate infection about the stump in supravaginal hysterectomy.





The first plate of six charts shows the type with apparently normal recovery. Nothing was found wrong with any one of them. Taken together, a very good composite chart may be formed. The highest temperatures are included with the others.

The second series had some slight reason for the rise except No. 9, which shows the elevation of temperature (102°) due to lobar pneumonia in the upper half of the left lung, from which the patient soon recovered. Effusion under the bladder reflexure was present in three of these patients, and was readily located when examination was made. Recovery followed without suppuration.

Abnormal distention due to imperfect preparation of the alimentary canal will send the temperature up as in Chart No. III, (2 cases), but the pulse rate may not be correspondingly increased. A laxative in these cases promptly brought the temperature down. Chart No. IV shows what may happen when the cervical canal cannot be reached and hence is not sterilized previous to operation. In the cases recorded, suppuration followed and pus was discharged through the cervical canal, which promptly lowered the temperature.

The last chart (No. V) shows how little the

temperature indicates the condition of the patient. She was a very ill woman with a large degenerating fibroid in the left broad ligament. Ten days after operation we found that a large hæmatoma had formed "under the peritoneal envelope" which finally disappeared without suppuration. The pulse was never over 100. The operation was performed November 4, 1913, and she is now perfectly well.

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# THE GROSS ANATOMY OF THE HUMAN PROSTATE GLAND AND CONTIGUOUS STRUCTURES[1]

By OSWALD S. LOWSLEY, M.D., New York
From the Pathological Laboratory, Bellevue Hospital

THIS report is based upon a study of two hundred and twenty-four prostate glands varying in age from one month to seventy-nine years, most of which were obtained from routine autopsies conducted by the pathological department of Bellevue Hospital. These specimens have been studied in gross, in sections, and microscopically, both in serial sections and in sections taken at random. It has seemed wise to consider in this communication only the gross characteristics of the structures at the neck of the bladder, as relationships at this complicated area are of the utmost importance to the genito-urinary surgeon.

The prostate gland is located behind the second portion of the rectum at the neck of the bladder, which it surrounds posteriorly and laterally. It is encircled by a sheath called the prostatic fascia, which is derived from the rectovesical fascia. This rather thin structure contains the vessels of the gland and is found just outside of the true capsule of the prostate. The gland is firmly attached to the bladder and urethra. It is held in position by several structures. Its apex is suspended superiorly by the puboprostatic ligament, which connects it with the pubic bone on either side. Inferiorly, it is joined to the rectum by the recto-urethralis muscle of the French writers (Poirier and Charpy), which is a reflection of the anterior portion of the levator ani muscle and is of great importance to the surgeon in doing a Young's perineal prostatectomy.

It is necessary to divide this muscle to prevent the danger of tearing into the rectum. The deep layer of the triangular ligament aids in fixing the apex because it invests the membranous urethra and is attached to the prostate. The lateral borders of the gland are embraced by portions of the levator ani muscle, which are separated from direct contact with it by a plexus of veins.

The lymphatics begin as a network around the acini of the gland, and pass outward forming another network under the capsule. From this point lymph-channels extend posteriorly to the external iliac glands, the lateral sacral glands, and the glands of the sacral promontory. Anteriorly, the lymphatics from the membranous and prostatic urethra join with those of the anterior part of the prostate and pass to a gland on the internal pudic artery.

The arteries supplying the prostate are derived from the internal pudic, the inferior vesical, and the middle hæmorrhoidal. They are rather small in size and reach the tubules of the gland through branches which enter the prostate in vessels passing through the septa separating the various lobes.

The veins form a plexus around the lateral and anterior surfaces of the gland (plexus of Santorini). They receive in front the dorsal vein of the penis and terminate in the internal iliac vein. The veins of this plexus are particularly large and tortuous on the anterior surface and are a common location for the formation of phleboliths. These pathological structures are found in over 50 per cent of my specimens older than 30 years. Nearly every specimen over 50 years has one or more.

[1] Read at the thirteenth annual meeting of The American Urological Association, Philadelphia, June 19, 1914.

Fig. 1. Shows moderate unilobular hypertrophy of Albarran's group with a raised contracted trigonum vesicæ and a moderately deep bas-fond. Bladder shows signs of obstruction.

The nerves of the prostate are derived from the hypogastric plexus.

The posterior surface of the prostate and seminal vesicles are covered by a glistening, rather light-colored fibrous plane of fascia which has been described by Denonvilliers. In some instances it is so thick and firm as to be almost leathery in consistency. It is always found extending to the apex of the gland. It covers its entire posterior surface and extends laterally for a short distance beyond the surfaces of the prostate. The upper border of the fascia varies greatly in its distribution. The most common arrangement is for that border to be semilunar in shape, the lowest point of the concavity being just above the place where the vasa deferentia approach each other and become bound together in the same envelope. Laterally, the fascia projects into a hornlike process on each side which covers the posterior surface of each seminal vesicle and becomes lost just above the upper end of that organ, gradually becoming interspersed with the fatty and areolar tissues which accompany and surround the seminal vesicles and vasa deferentia. Nature has provided this firm barrier between the posterior surfaces of the prostate and seminal vesicles and the rectum, and its presence and the presence of the intervesicular fascia to be described later undoubtedly explain why carcinoma of the prostate and seminal vesicles involve the rectum, if at all, high up and at a very late stage in the disease. This fascia adheres with moderate firmness to the posterior surfaces of the organs mentioned everywhere except at the upper border of the posterior lobe of the prostate, where it becomes very intimately attached and is only separated from it with the greatest difficulty. In fact, there is a leaflet of the fascia which extends down between the gland and the

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Fig. 2. Shows enlargement of Albarran's group in the shape of a very thick letter U extending from the upper end of the verumontanum within the sphincter and into the bladder, which shows signs of obstruction.

Fig. 3. Shows the separation of one-half of trigonum vesicæ after boiling in dilute acetic acid according to method of Mall. The trigonum is lifted completely from vesicle wall.

vesicles and is tightly joined to the capsule of the prostate. The fascia is a very sharply outlined structure except at the ends of the hornlike process mentioned above. Considerable variation is noticed in the position of its upper border. A common variation is its extension much farther upward than has been described, in which instances the upper margin is less concave and may even extend directly across from the upper end of one seminal vesicle to that of the other. The blood supply is limited. Small vessels are observed coursing through the tissue, practically all of them being confined to its upper layer or that portion which comes in contact with the prostate gland and the seminal vesicles.

The prostate gland is often described as having the appearance of a horse-chestnut or English walnut, but neither of these comparisons seems to be sufficient. Its posterior surface is triangular and flattened. It usually has a depression extending longitudinally in its midline which is most prominent towards the base of the gland and rarely, if ever, exists at the anterior one-third. Its upper border bulges on each side, as do the lateral borders, due to the fact that the lateral lobes form the main mass of the gland. The upper border receives the ejaculatory ducts after the junction of the vasa deferentia with the seminal vesicles in an elliptical funnel-shaped depression. The lateral borders are rounded, and there is a fairly sharply defined area between the lateral borders and the upper surface of the gland. In young specimens obtained before puberty there is far less lateral and posterior bulging, but the general contour is about the same.

Careful measurements of two hundred and twenty-four specimens obtained from routine autopsies have disclosed some very interesting facts. The width of the gland in every instance is greater and the thickness always less than the anteroposterior diameter. There is always greater prominence of the lateral than the middle portions of the base, so that in adult prostates the distance from the apex to the lateral prominences exceeds that from the apex to the middle of the base by 0.2 cm. to 0.5 cm.

Nearly all of the specimens obtained from children dying in the first decade were less than five years of age. During this time a very slow gradual increase in size is observed, so that at five years of age the prostate is surprisingly little larger than it is at birth. Thirty-eight specimens examined showed no abnormalities, except one case described in another paper in which there was an obstruction at the lower end of the verumontanum which caused hydronephrosis, and ultimately the death of the child at three months of age. The average length of the prostate during the first half of the first decade is 1.2 cm. The width is 1.5 cm. and the average length is 0.9 cm. As might be expected, the greatest development of the prostate occurs during puberty. In ten specimens examined which were older than 15 years, the average length is 3.0 cm., which is more than twice the size at the fifth year. There is even a greater increase in the width, the average being 3.8 cm.; the height or thickness averages 2.1 cm. It is thus seen that the gland assumes almost adult proportions during the latter part of the second decade. During the third decade the prostate reaches adult size. Any change in dimensions after that time is only a matter of a few millimeters. The forty glands measured vary in length from 2.8 cm. to 4.0 cm., the average being 3.3 cm. The width shows a greater variation, the narrowest being 3.6 cm., and the widest being 5.2 cm. There is no gross evidence of adenomatous hypertrophy in the latter specimen. The average width is 4.1 cm., while the average height or thickness is 2.4 cm.

Thirty-three specimens obtained from individuals who died during the fourth decade of life show a slight falling off in size, the average length being 3.15 cm., a little less than in the preceding decade. The width is 4.1 cm. and the length 2.55 cm., which is a trifle more than in the third decade.

Forty-two specimens between 40 and 50 years are a little larger than those of the younger periods. The length is 3.45 cm., width 4.0 cm., and thickness 2.65 cm. There is less change in the measurements of the various glands observed and there seems to be slightly more uniformity as regards size.

The prostate gland reaches its maximum

size during the sixth decade, at which period all of its dimensions are increased slightly more than the post-puberty glands. The twenty-nine specimens obtained show the following averages: Length 3.65 cm., width 4.37 cm., thickness, 2.75 cm.

There is a very slight decrease in the size of the thirty-two prostates older than 60 years which have been examined. The subjects from whom these specimens were obtained died at ages varying from 60 to 79 years. Frankly hypertrophied glands are not considered in this discussion. By comparing figures it is seen that the old-age prostates average about the same size as those of the third decade, being a little larger than those of the post-puberty period and somewhat smaller than those of the sixth decade. In length they vary from 2.6 cm. to 4.5 cm., with an average of 3.23 cm.; the average width is 4.12 cm., the smallest being 3.0 cm., and the largest 5.0 cm. The prostate having the greatest thickness measured 3.6 cm., the least 2.0 cm., while the average for all glands of this period is 2.47 cm. (See Table I.)

Abnormalities occur in the series of specimens concerned in this report in a great many more cases than is generally supposed. Out of the two hundred and twenty-four specimens of all ages including thirty-eight under five years of age, there occurred sixty-one cases of abnormalities of the prostate gland itself or accessory structures. Of these, thirty-three, or 14.7 per cent, are enlargements of Albarran's subcervical group of glands with resulting obstruction to urinary outflow; twenty-five cases of general glandular enlargement are found, which is 11.1 per cent of the entire number collected. Therefore, 25.8 per cent of all specimens show some obstruction at the vesical neck. There are enlargements of the subtrigonal group of three of the specimens, but in none of them is the enlargement sufficient to cause obstruction.

The largest number of enlargements of Albarran's group occur at the fourth decade, during which period 27.3 per cent of my specimens show this complication. In the fifth decade there are 23.8 per cent with Albarran's hypertrophies and 17.2 per cent during the sixth decade. Only 5 per cent of the third decade prostates show an enlargement of the subcervical group, and before this age no such abnormality is observed. It is interesting that 22.8 per cent, or more than one out of every five prostates, show this important condition after the thirtieth year.

The enlargements of the subcervical group of Albarran vary a great deal in regard to their size and shape. About 50 per cent of them are small in size, and consist of a single projecting nodule which pushes its way up from the floor of the orifice and within the vesical sphincter[1] for varying distances in such a way that in the relaxation of the vesical orifice the nodule has a tendency to drop outward and that tendency is augmented by straining, so that more or less obstruction is caused by every enlargement of this sort, the amount of obstruction depending not only upon the size of the structure, but upon the extent to which

[1] Specimens, prepared by heating in dilute acetic acid after the method of Mall in which the connective tissue is dissolved allowing easy isolation of muscular structures and gland tissue, show the manner in which Albarran's group is superimposed upon the floor of the vesical sphincter.

TABLE I

SHOWING CHANGES IN SIZE OF THE PROSTATE GLAND AT VARIOUS AGES

| Age | Number of Cases | Length | | Width | | Thickness | |
|---|---|---|---|---|---|---|---|
| | | Variation | Average | Variation | Average | Variation | Average |
| First decade. 1 to 10 years | 38 | 1 cm. to 1.7 cm. | 1.2 cm. | 1 to 2 cm. | 1.5 cm. | 0.7 to 1.3 cm. | 0.9 cm. |
| Second decade. 10 to 20 years | 10 | 2.5 to 3.5 cm. | 3 cm. | | 3.8 cm. | 1.8 to 2.4 cm. | 2.1 cm. |
| Third decade. 20 to 30 years | 40 | 2.8 to 4 cm. | 3.3 cm. | 3.6 to 5.2 cm. | 4.1 cm. | 2 to 3 cm. | 2.4 cm. |
| Fourth decade. 30 to 40 years | 33 | 2.4 to 4 cm. | 3.15 cm. | 3 to 5 cm. | 4.1 cm. | 1.6 to 3 cm. | 2.55 cm. |
| Fifth decade. 40 to 50 years | 42 | 3 to 4.6 cm. | 3.45 cm. | 3.6 to 5 cm. | 4 cm. | 2.3 to 3.8 cm. | 2.65 cm. |
| Sixth decade. 50 to 60 years | 29 | 2.4 to 4.5 cm. | 3.65 cm. | 3.3 to 5 cm. | 4.37 cm. | 2.4 to 3.4 cm. | 2.75 cm. |
| Old age, 60 years and older | 32 | 2.6 to 4.5 cm. | 3.23 cm. | 3 to 5 cm. | 4.12 cm. | 2 to 3.6 cm. | 2.47 cm. |

it projects into the bladder. All of the small specimens and most of the large ones are unilobular, but a number of the larger specimens are trilobular, the enlargement being divided into three distinct masses. In my opinion, this division is brought about by the pressure caused by the muscular bands, so-called "Bell's muscles," extending from the ureteral orifices to the upper end of the verumontanum and forming the lateral borders of the trigonum vesicæ. These trilobular tumors exist often as masses joined tightly together at the base. Occasionally they are entirely separated from one another. One of the specimens has a middle portion which is almost entirely overlapped by the two lateral. It has been called to my attention by Dr. H. W. Plaggemeyer[1] of Detroit, and borne out by my own observations, that a true middle lobe enlargement does not project through the sphincter, but when that portion of the gland enlarges alone it lifts the sphincter up as well as the apex of the trigonum and is always outside of the sphincter although it may cause it to be thinned out markedly by its upward pressure. Glandular hypertrophies at the vesical orifice show a very complex anatomical arrangement, and this subject is worthy of a much more thorough study.

General enlargement of the prostate gland occurs most frequently among those past 60 years which have been grouped as old age specimens. Thirty-one and two-tenths per cent of the thirty-two specimens obtained from subjects of this period have a moderate general enlargement of the gland. The younger groups have comparatively few enlarged glands among their number. One specimen slightly enlarged occurs in the third decade. In the group comprising the fourth decade 12.1 per cent show adenomatous hypertrophy of slight degree, while during the fifth and sixth decades the percentage of enlarged prostates is 16.7 and 10.3 respectively. Fourteen and one-tenth per cent of all specimens examined over 20 years of age have a general enlargement. By grouping all specimens over 30 years, 17.5 per cent are found to be enlarged. (See Table II.)

The ureters pass obliquely through the vesical wall in such a way that, upon distention of that organ, pressure is exerted upon the tubular structures, completely occluding them. It is important to the surgeon who catheterizes and operates upon ureters to know the length of that part of the ureter which is contained within the bladder wall. In the series of cases here investigated, four hundred and forty-eight ureters were measured, and the following averages for the various decades of life are noted: From the time of birth up to five years of age the distance of the ureter through the vesical wall is 0.75 cm.

[1] Verbal communication.

TABLE II

SHOWING THE OCCURRENCE OF ABNORMALITIES

| Age | Hypertrophy of Albarran's Group | | | General Hypertrophy | | Hypertrophy of Subtrigonal group | No. of Specimens. | Percentage of Albarran's Hypertrophy | Percentage of General Hypertrophy | Percentage of Subtrigonal | Percentage of Abnormalities |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Large | Medium | Small | Large | Slight | | | | | | |
| First decade. 1 to 10 years. | 0 | 0 | 0 | 0 | 0 | 0 | 38 | 0 | 0 | 0 | 0 |
| Second decade. 10 to 20 years | 0 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 0 | 0 |
| Third decade. 20 to 30 years | 0 | 0 | 2 | 0 | 1 | 0 | 40 | 5 | 2.5 | 0 | 7.5 |
| Fourth decade. 30 to 40 years | 2 | 0 | 7 | 0 | 4 | 1 | 33 | 27.3 | 12.1 | 3 | 42.4 |
| Fifth decade. 40 to 50 years | 4 | 2 | 4 | 1 | 6 | 0 | 42 | 23.8 | 16.7 | 0 | 40.5 |
| Sixth decade. 50 to 60 years | 1 | 2 | 2 | 2 | 1 | 1 | 29 | 17.2 | 10.3 | 3.4 | 3.9 |
| Old age. 60 years and older | 1 | 3 | 3 | 3 | 7 | 1 | 32 | 21.9 | 31.2 | 3 | 56.1 |
| Total for all ages | 8 | 7 | 18 | 6 | 19 | 3 | 224 | | | | |

Percentage of Albarran's hypertrophies, all ages considered ..... 14.7
Percentage of general hypertrophies, all ages considered..... 11.1
Percentage of Albarran's hypertrophies, after the 20th year .... 18.7
Percentage of general hypertrophies, after the 20th year..... 14.1
Percentage of Albarran's hypertrophies, after the 30th year .... 22.8
Percentage of general hypertrophies, after the 30th year..... 17.5

and the average size of the ureteral orifice is 0.1 cm. During the second decade there is an increase in the length of the ureter within the wall of the bladder to 1.6 cm., and it remains about the same throughout except that there is a slight increase in this measurement in the latter years of life, it being 1.7 cm. in the sixth decade and 1.9 cm. in old age. The ureteral orifices do not show any marked change after the second decade, at which time they are 0.25 cm. in length and are nearly always scaphoid in shape, although they may be mere slits or exactly circular. There are a great many variations in the appearance of ureteral orifices, and one may find any stage between the small circular orifice which looks like a pin hole to a long narrow slit 1.0 cm. long.

The trigonum vesicæ is formed by the muscular and connective-tissue bundles extending from each ureter to the vesical orifice which are superimposed upon the bladder wall. The fibers from its apex connect with the upper end of the verumontanum and are seen to be arranged in a varying number of folds, usually two or three. This structure is normally an equilateral triangle, although the base or distance between the ureteral orifices is often a little less than the distance between ureter and the vesical orifice. In the first decade the average trigonum measures 1.2 cm. This increases in the second decade to 1.6 cm. During the third period it reaches adult size, 2.2 cm., and remains practically the same throughout adult life.

The superposition of the trigonum upon the bladder wall, as described by Lieutaud, can be demonstrated by Mall's method, already described, in which the structure is dissected entirely free from the vesical wall (Fig. 3).

Asymmetry of the trigone occurs with considerable frequency. In my series it occurs most frequently in the fourth decade. Fifty-nine of the entire number of specimens, or 26.3 per cent, show a considerable difference in the distance of the two ureters from the vesical orifice. This variation may be as much as 1.2 cm., and in this day of instrumental investigation of the bladder and ureters this is an important consideration. In adults the ureters may be as near to the vesical orifice as 1.5 cm., or as far from it as 5.0 cm. Eight and one-half per cent of my specimens have a trigonum vesicæ more than 1.0 cm. larger than normal, while 2.7 per cent are unusually small without other signs of abnormality. Seventeen specimens, or 7.6 per cent, show an hypertrophy of the trigonum vesicæ which stands out markedly superimposed upon the bladder. It is in every such case somewhat contracted with a deep bas-fond behind its base. This condition rarely, if ever, occurs before the fortieth year.

Abnormalities in the structure of the trigonum vesicæ are very frequently met with. The existence of an hypertrophy of the group of fibers extending from one ureter to the other is so common an occurence that a so-called interureteric bar is taken for granted in adults. I have come across a number of specimens in which there is apparently no tissue extending from one ureter to the other, but there is a distinct bundle extending from each ureter to the vesical orifice. Frequently bundles of fibers extend toward the middle line and then curve rather sharply toward the apex, forming a wide V-shaped structure. Several of the specimens show the remarkable condition of a bar extending from one ureter just to the midline where it stops off short, and extending from the other ureter to the orifice of the bladder there is a well marked bundle of fibers.

The prostate develops in such a manner that its main bulk lies behind the urethra and lateral to it. There is comparatively little of the gland anterior to the lumen of the urethra. At the apex of the gland there is about an equal distribution of tissue anteriorly and posteriorly. In every young specimen the urethra proceeds through the gland almost in its center except at the base, where there is, even before the time of puberty, a preponderance of tissue posteriorly.

As persons grow older there is a gradual increase in the distance from the vesical orifice to the upper margin of the verumontanum. Up to the fifth year this measurement averages 0.55 cm. During the second decade the length of this portion of the posterior urethra is increased to 1.2 cm., and from that age on there is a slow, gradual increase in its measure-

ment. In the cases of enlargement of the subcervical group the urethra is very much lengthened at this point, but since such abnormal cases are not included in the measurement it is concluded that the upper end of the posterior urethra tends to lengthen in the later years of life so that in old age the average measurement from the beginning of the urethra to the upper end of the verumontanum is 1.85 cm.

The verumontanum, formed by the ingrowth of the wolffian and müllerian ducts, assumes various shapes and sizes at different points. The usual arrangement is for the upper end to rise abruptly from the floor of the urethra, its greatest height and width being at the point where the ejaculatory ducts and utricle open into the urethra, which is usually about 0.3 cm. below its upper end. From this point on, the structure usually tapers off gradually until its fibers have become distributed among those of the floor of the urethra and it disappears at its lower end by spreading out in one to four or five bands of tissue, some of which may become attached to the lateral walls of the urethra. Its length in the first decade is 1 cm. During the second it becomes increased to 1.5 cm., and at the third period it assumes adult size, and is nearly 2.0 cm., throughout life. The width and height follow rather closely the length in regard to reaching adult proportions, which are a little over 0.4 cm. in either direction and about twice the size of the structure in the first decade.

The seminal vesicles and the lower portions of the vasa deferentia are bound together by a fascia which I have called the intervesicular fascia. It is made up of three portions, the most prominent being the posterior leaflet, which is composed of two layers. It extends around and between the two seminal vesicles and posterior to the vasa deferentia. The seminal vesicles are thus suspended in a sac-like structure, the posterior layer of which extends directly across from one vesicle to the other. The anterior layer, after encircling the vesicles, joins the posterior lamella at the border of each vesicle and becomes intimately attached to it, thus forming a two-layered, rather firm fibrous fascia. The middle portion is formed by a two-layered structure which envelops the vasa deferentia in a similar manner. The third or anterior lamella is a single-layered fibrous structure extending from the anterior and lateral surfaces of one seminal vesicle to those of the other, at which point it is attached to the encircling portions of the posterior part of the fascia described above. In most instances the upper border of this fascia extends somewhat higher than the fascia of Denonvilliers, and the two structures are easily separated, being in direct contact only at the lateral surfaces of the seminal vesicles. At other places the two structures are separated by a considerable amount of fatty and areolar tissue.

The intervesicular fascia is not nearly so firm as that of Denonvilliers. Its posterior leaflet is the strongest portion; the middle, or that portion which encircles the vasa deferentia, is the weakest. The three lamellæ combined hold the seminal vesicles and vasa deferentia in a very definite envelope, which is of considerable importance in surgery of this region. This structure is undoubtedly a barrier to the extension of carcinoma and may explain why cancer of the seminal vesicles is usually confined to those structures for such a long period of time without extension to surrounding tissues and organs. The type of pain which accompanies acute infections of the seminal vesicles is explained by the fact that these organs are contained within a sacculated fascia. The intervesicular fascia corresponds fairly well to the area of the trigonum vesicæ and, reinforced by the fascia of Denonvilliers, forms a firm support to the bladder wall at this area and is an additional factor in preventing the formation of diverticula in this region. The elevation of the lower portion of the trigonum vesicæ in true middle-lobe hypertrophies is materially influenced by the fibrous, unyielding character of this fascia and the yielding nature of the bladder-wall.

The seminal vesicles attain adult size during the third decade. The average of a great many measured shows that in health they remain practically the same size after this period. Enlargement of these structures occurs in 32.4 per cent of all cases over 20 years of age. The greatest period of affection is during the third decade, at which time 42.5 per cent are abnormal. The right seminal

TABLE III

SHOWING ABNORMALITIES OF SEMINAL VESICLES

| Age | Right Enlarged | | | Left Enlarged | | | Both Enlarged | | | Atrophied | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Large | Medium | Slight | Large | Medium | Slight | Large | Medium | Slight | Right | Left | Both |
| First decade. 1 to 10 years | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Second decade. 10 to 20 years | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Third decade. 20 to 30 years | 2 | 2 | 10 | 0 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 0 |
| Fourth decade. 30 to 40 years | 2 | 2 | 1 | 0 | 0 | 2 | 3 | 0 | 0 | 0 | 0 | 2 |
| Fifth decade. 40 to 50 years | 1 | 2 | 5 | 0 | 0 | 1 | 1 | 0 | 1 | 0 | 0 | 1 |
| Sixth decade. 50 to 60 years | 3 | 3 | 0 | 1 | 0 | 1 | 0 | 0 | 2 | 0 | 0 | 1 |
| Old age. 60 years and older | 2 | 0 | 2 | 1 | 0 | 3 | 1 | 0 | 0 | 0 | 0 | 1 |

Percentage of enlarged seminal vesicles more than 20 years..... 32.4
Percentage of enlarged seminal vesicles in third decade..... 42.5
Percentage of enlarged seminal vesicles in fourth decade..... 30.3
Percentage of enlarged seminal vesicles in fifth decade..... 26.2
Percentage of enlarged seminal vesicles in sixth decade..... 34.5
Percentage of enlarged seminal vesicles in old age..... 28.1

vesicle is enlarged three times as often as the left in this series, there being thirty-seven cases of the former and ten of the latter, and ten in which both sides are symmetrically enlarged. There are five cases of atrophy of both structures. (See Table III.)

The ejaculatory ducts pass obliquely through the prostate. They retain their embryological characteristics of rising rather precipitously through the prostate until they are within a short distance of the lumen of the urethra in the verumontanum, at which point they turn and course through the verumontanum parallel with the axis of the urethra, finally opening laterally on the surface of that structure in such a manner that there are left thin flaps over their orifices which act as valves on distention of the posterior urethra. They open on a level with the upper portion of the utricle and in none of the two hundred and twenty-four specimens studied have I found an ejaculatory duct opening into the utricle. Porosz[1] has reported three hundred cases examined with no instance of an ejaculatory duct opening into the utricle.

The mouth of the utricle is very small in the first decade, considerably larger in the second, and reaches adult size in the third. It varies greatly in size and shape; the average adult size is 0.15 cm. The shape of the orifice is a longitudinal slit which varies greatly as to its width. Often the orifice is small and round; in other cases the longest diameter is obliquely or transversely disposed, and occasionally it is semilunar in shape. In one or two instances the orifices of ejaculatory ducts and utriculus prostaticus are elevated and look like little craters. The depth of this interesting vestigial organ is rarely very extensive, since it is usually completely contained within the tip of the verumontanum. Occasionally, however, it extends to the base of the prostate, in which case it measures over 1.0 cm. During the first four decades it is less than 0.5 cm. in length, but in later years it becomes a trifle more extensive, as shown in the accompanying table. (See Table IV.)

[1] Archiv f. Anat. u. physiol. Anat., Leipzig, 1913, Suppl. bd. 172.

## SUMMARY

The veins of the prostate are numerous, and in old age large and tortuous. They are located for the most part on the anterior surface and the lateral borders of the gland. Phleboliths are quite commonly found in them. These vein stones are found in 50 per cent of all specimens over 30 years of age, and in every specimen over 50 years.

The so-called median groove of the prostate is a depression which extends parallel with the axis of the gland, and is found only in the posterior two-thirds of that structure, the anterior third being rounded. The width of the gland in every instance is greater, and the thickness always less, than its length. There is a very slow, gradual increase in the size of the prostate from birth to five years of age. It increases very rapidly in size during the

TABLE IV

SHOWING MEASUREMENTS OF ACCESSORY STRUCTURES

| Ages | Length of Ureter Through Vesical Wall | Size of Ureteral Orifices | Size of Trigonum Vesicæ | | Distance from Vesical Orifice to Verumontanum | Size of Verumontanum | | | Utricle | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Ureter to Vesical Orifice | Distance Between Ureters | | Length | Width | Height | Size of Mouth | Length |
| 1 to 10 years | 0.75 cm. | 0.1 cm. | 1.2 cm. | 1.0 cm. | 0.55 cm. | 1.0 cm. | 0.2 cm. | 0.2 cm. | 0.01 cm. | 0.4 cm. |
| 10 to 20 years | 1.6 cm. | 0.25 cm. | 1.6 cm. | 1.4 cm. | 1.2 cm. | 1.5 cm. | 0.3 cm. | 0.4 cm. | 0.1 cm. | 0.5 cm. |
| 20 to 30 years | 1.45 cm. | 0.4 cm. | 2.2 cm. | 2.2 cm. | 1.3 cm. | 2.0 cm. | 0.4 cm. | 0.3 cm. | 0.17 cm. | 0.5 cm. |
| 30 to 40 years | 1.75 cm. | 0.3 cm. | 2.4 cm. | 2.0 cm. | 1.16 cm. | 1.8 cm. | 0.43 cm. | 0.46 cm. | 0.15 cm. | 0.5 cm. |
| 40 to 50 years | 1.65 cm. | 0.36 cm. | 2.45 cm. | 2.3 cm. | 1.55 cm. | 1.95 cm. | 0.45 cm. | 0.49 cm. | 0.19 cm. | 0.7 cm. |
| 50 to 60 years | 1.7 cm. | 0.2 cm. | 2.2 cm. | 2.2 cm. | 1.75 cm. | 1.7 cm. | 0.43 cm. | 0.43 cm. | 0.13 cm. | 0.7 cm. |
| 60 years and older | 1.9 cm. | 0.25 cm. | 2.22 cm. | 2.3 cm. | 1.85 cm. | 1.85 cm. | 0.43 cm. | 0.5 cm. | 0.19 cm. | 0.86 cm. |

years of puberty, so that just after this period it is more than twice as large in every dimension as it was preceding this age. During the third decade the gland reaches its maximum size. It shows a very slight decrease in size in old age.

Changes in the prostate gland or other contiguous structures, causing abnormality of greater or less degree at the vesical orifice, occur in sixty-one cases out of two hundred and twenty-four studied. Fourteen and seven-tenths per cent of the entire number of glands observed show an enlargement of Albarran's subcervical group of tubules. Most of these occur after the thirtieth year, so that 22.8 per cent of the specimens older than this show such an abnormality. General enlargement of the prostate occurs in 11.1 per cent of all the glands studied. There are three enlargements of the subcervical group. The usual Albarran's group enlargement is unilobular. Occasionally this enlargement may be divided into three portions. There are two types of obstruction with intravesical projection at the posterior portion of the neck of the bladder. The most common is an enlargement of the subcervical group with projection from within the sphincter; the second type is an enlargement of the middle lobe proper which develops outside of the sphincter and projects into the bladder by lifting the apex of the trigonum vesicæ.

The ureters pass obliquely through the vesical wall in such a manner that intravesical pressure causes occlusion of their lumina. The length of the ureter contained within the bladder musculature varies at different ages. During the first decade it averages 0.75 cm. in length. Its length is much increased during the second decade, at which time it becomes 1.6 cm. in length, and during later years in life increases only slightly. In adult life the ureteral orifices are scaphoid in shape and about 0.25 cm. in their greatest diameter. They vary greatly, however, in shape and size.

The trigonum vesicæ is normally an equilateral triangle in which the base or the distance between the ureters is occasionally less than the other legs of the triangle. It reaches adult proportions during the third decade, and in normal cases remains unchanged throughout life. Anatomically, it is formed by tissue derived from the ureters and superimposed upon the bladder-wall as described by Lieutaud. Abnormalities of the trigonum are rather common: 26.3 per cent of the specimens in my series show an asymmetry of this structure. The difference in distance between the ureter on each side and the vesical orifice may be as great as 1.2 cm. The base of the trigonum in adults may be as near to the internal sphincter as 1.5 cm. or as far from it as 5 cm. Seven and six-tenths per cent of the specimens show an hypertrophy of this structure. This does not occur in any instance before the fortieth year. There are a great many abnormalities in the arrangement of the muscular bundles comprising the trigonum vesicæ.

There is a great increase in the distance be-

tween the vesical orifice and the upper margin of the verumontanum. This distance is 0.55 cm., in the first decade. During the second it increases to 1.2 cm., and from that time on there is a gradual lengthening of this portion of the posterior urethra until in old age it reaches a distance of 1.85 cm. Enlargement of Albarran's subcervical group greatly augments this measurement.

The verumontanum assumes adult size during the third decade. It is attached to the trigone above by small bundles of fibers. Below the entrance of the ejaculatory ducts and utricle it gradually decreases in size, its fibers spreading out in small bundles on the floor and occasionally on the lateral walls of the urethra.

The seminal vesicles and lower ends of the vasa deferentia are bound together by a structure composed of anterior, middle, and posterior lamellæ. This fascia is of interest because it tends to prevent the dissemination of carcinoma of the seminal vesicles to contiguous structures, it causes a true middle-lobe hypertrophy of the prostate to project into the bladder, and it supports the base of that viscus. The seminal vesicles attain adult size during the third decade, and normally do not enlarge after that period. Abnormal enlargement occurs in 32.4 per cent of all cases over 20 years of age. The right side is enlarged three times as often as the left. Atrophy of the seminal vesicles occasionally occurs. There are five cases in my series.

There has not been found a single instance in which an ejaculatory duct opened into the utricle in this series. Porosz reports three hundred cases without any such abnormal arrangement. The utriculus prostaticus is usually contained within the summit of the verumontanum. Occasionally it extends to the base of the gland. During the first four decades it is less than 0.5 cm. in length. In later years it becomes a trifle longer. Great variation is noticed in the size and shape of the mouth of the utricle, but the usual arrangement is a longitudinal scaphoid slit. One interesting specimen had its orifice entirely occluded by a membrane.

In no instance has there been found an hypertrophy of the ventral or the posterior lobes of the prostate or the apex group of tubules, although I have a clinical case in which there is a decided enlargement of the latter which is probably due to chronic infection and is subsiding under treatment.

The following conclusions are drawn from this study:

1. The width of the prostate in every instance is greater than the height, always less than its length.

2. The prostate gland develops very slowly until puberty, at which time it increases enormously in size, assuming proportions which are twice those previous to this period. It reaches a maximum size during the third decade.

3. One out of every four specimens observed shows an obstruction of greater or less extent at the orifice of the bladder.

4. Asymmetry of the trigonum vesicæ frequently occurs (26.3 per cent of my cases).

5. The upper portion of the posterior urethra continually lengthens from birth until death.

6. The seminal vesicles and the lower end of the vasa deferentia are enveloped in a triple-layered fascia, which is of great importance surgically. Enlargement of the seminal vesicles occurs in one-third of the cases over 20 years of age, the right being affected three times as often as the left.

7. The ejaculatory ducts rarely, if ever, open into the utriculus prostaticus.

In conclusion I wish to express my thanks to Dr. Charles Norris, Dr. Crawford, and Dr. Vance of the pathological department at Bellevue Hospital and to Dr. Hugh H. Young of Baltimore for their many courtesies.

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# NERVE-BLOCKING[1]

By M. L. HARRIS, M.D., Chicago

IT has been the aim of surgeons from time immemorial to render surgical operations painless. While the early attempts undoubtedly mitigated somewhat the pain of operations, success in this line cannot be said to have been achieved until the advent of ether and chloroform. The use of these agents produces an abolition of consciousness, and during this state no pain is perceived. For years after the discovery of these and other general anæsthetics the abolition of consciousness was considered essential to complete freedom from pain during operations, but following an article by Koller, in 1884, on the anæsthetizing effect of cocaine when applied to the mucous membrane of the eye much experimentation was done in order to determine the practical value of cocaine, when applied locally to mucous membranes or when injected subcutaneously, in producing local anæsthesia so that the part could be operated on without pain. It was found that cocaine, when applied to a mucous membrane, would produce practically complete anæsthesia, although somewhat superficial in character, and that when injected subcutaneously an area of anæsthesia would be produced varying in duration and extent, depending upon the strength of the solution used. The very high toxicity of cocaine made the subcutaneous use of this drug for its local anæsthetizing effect so dangerous as to limit the practical applicability of the method to comparatively slight operations, and after enjoying a rather brief period of favor the method fell into disuse, except in certain cases.

It was observed very early that if the cocaine solution were injected in close proximity to a sensory nerve trunk the area of anæsthesia was not limited to the region injected, but extended to the entire region supplied by the nerve with which the solution had come in contact. It seems that but little use was made of this principle at the time, but shortly thereafter the anæsthetizing effect of cocaine when injected into the central spinal canal was brought forward and spinal anæsthesia became quite popular; but its high mortality soon put a check to its general adoption.

The possibility, however, of producing anæsthesia sufficiently for surgical purposes without the abolition of consciousness was demonstrated, and the desirability of the method, together with its great advantages, provided it could be freed from the dangers due to the toxicity of the substances used, at once became apparent.

The search for something less toxic than cocaine led to the discovery of a number of substances, which, when applied locally, produce anæsthesia. Among these may be mentioned the various forms of eucaine, tropocaine, stovaine, alypin, orthoform, cycloform, novocaine, etc. None of these substances possesses anæsthetizing properties to the same high degree as does cocaine, but they are all less toxic than cocaine. Of these substances novocaine seems to be the best, as it possesses a comparatively low toxic coefficient combined with high anæsthetizing properties. It is also readily soluble in water and will stand a reasonable amount of boiling without decomposition.

While experiments show that novocaine is only about one-seventh as toxic as cocaine, it should not be forgotten that serious and even fatal results may follow an overdose. The amount of novocaine that can be injected without producing toxic symptoms varies considerably and depends largely upon the rapidity of absorption. If a plain watery solution be used and injected in a region where absorption is rapid, 0.3 gms. to 0.4 gms. may produce symptoms; but if the solution be one which absorbs slowly 0.5 gms. to 1.0 gm. may be used without danger. The more rapid the absorption the less marked the anæsthesia, for it requires a certain length of time for the drug to act. The addition of adrenalin to the solution materially increases the degree and duration of the anæsthesia.

[1]Read before American Gynecological Society, May, 1914.

Hoffmann has found that the addition of ¼ of 1 per cent to 1 per cent of potassium sulphate also materially increases the duration of the anæsthesia, and that he was able to produce anæsthesia with a much weaker solution.

I have found in my own work that by the addition of calcium chloride in varying strengths the anæsthesia may be prolonged to two or three hours without difficulty, and that a weaker solution may be used than without the calcium chloride. The formula which I am using at present and which has given me the best results is novocaine, ¼ to 1 per cent, calcium chloride ¼ to ½ of 1 per cent, chlorbutanol 8/10 of 1 per cent in distilled water, to which are added 4 to 5 drops of the 1 to 1000 adrenalin solution to 30 ccm. of the mixture. It is very essential that the mixture be properly prepared, and the method which I use is as follows: The distilled water is sterilized by boiling. The novocaine is then added and the boiling continued not to exceed two or three minutes, as prolonged boiling spoils novocaine. When this has cooled down to below 160° Fahr., 1.0 gm. of chlorbutanol is added to every 100 ccm. of the novocaine solution. Water dissolves only about .8 of 1 per cent of chlorbutanol, but 1 per cent is added merely as an easy way of insuring a saturated solution. The undissolved part simply settles at the bottom. A 2 per cent to 4 per cent solution of calcium chloride in distilled water is made and sterilized, and then the chlorbutanol added the same as to the novocaine solution. The solutions are kept separate and mixed just before using. In this way the percentages of the ingredients may be quickly varied to suit the particular case. The adrenalin should never be added until just before using, as it is very unstable and soon spoils if left standing in the solution, which is indicated by the solution gradually turning a reddish color. The adrenalin solution should be comparatively fresh, and if it has turned reddish in color it should not be used. The chlorbutanol is added because it has distinct anæsthetizing properties of its own, and, being soluble in lipoids, increases the anæsthetizing effect of the novocaine.

If this solution be brought in contact with a nerve, it penetrates the nerve and interrupts or blocks the passage of nerve impulse at that point. If the nerve be a mixed one, afferent impulses are blocked before efferent. If the blocking is complete, no afferent impulses can travel along the nerve at the point of blocking; hence no sensations having their origin in the region supplied by the nerve blocked can be perceived. Sensations are of several kinds: touch, pain, temperature, pressure, etc. When a nerve is blocked, the sensations are not all lost at the same time. Pain is lost first, and pressure last. The prick of a pin may be recognized after it ceases to be at all painful, and pressure can usually be recognized after touch is lost.

On making an incision through the abdominal wall, for example, it is found, as might be expected, that the skin is the most sensitive. The subcutaneous fat is but slightly sensitive, while the muscle and parietal peritoneum are quite sensitive. I have observed several times that the patient would complain of feeling the cutting of the muscle when absolutely nothing was felt when the skin or peritoneum was cut. The complete absence of muscular rigidity and of increased abdominal tension is a certain indication that the peritoneum, where it is being handled, is anæsthetized. When the abdomen is opened under a circumscribed blocking, it is very interesting to rub or draw on the parietal peritoneum outside of the blocked area and to note the character and location of the sensations described by the patient. For instance, if the lateral parietal peritoneum be drawn on, as may be done usually when there are adhesions between the colon and the lateral wall, the patient at once complains of a pain in the side; rubbing the peritoneum over the bladder, or over the lower abdominal wall, causes a sensation in the bladder with the desire to urinate; on rubbing the peritoneum of the cul-de-sac of Douglas the pain is referred to the rectum.

The uterus and ovaries are not particularly sensitive when touched, but if the infundibulopelvic or the broad ligament be drawn on pain is produced which is referred to the lateral wall of the pelvis. Handling or draw-

ing on the gall-bladder and ducts causes pain referred to the back. The appendix is absolutely insensitive, but ligating or drawing on the mesenteriolum causes a pain similar to an intestinal colic, which is referred to the region of the umbilicus with gagging, and if persisted in vomiting may be induced. This may be prevented very readily by simply injecting the root of the mesenteriolum with the anæsthetizing fluid. The same kind of a pain may be produced by drawing on the mesentery of any part of the intestine, and it is so characteristic that it may be called the intestinal pain.

As the principle of nerve-blocking consists in reaching the nerve in continuity at the most accessible point between the part to be operated on and the spinal cord, or the brain, it necessarily follows that one should be a good anatomist in order to block successfully. One should know, too, the limitations of the method, although it may be said that its field is continually increasing with improved technique.

### LIMITATIONS AND AVAILABILITY

We will take up now the limitations and the availability of nerve-blocking more in detail. As might be expected, the method is not suited to operations on infants or children too young to be governed by reason, as they resist and struggle through fear, uninfluenced by the presence or the absence of pain, yet I would not place a definite age limit, as I have operated on a little girl of five years for a good-sized inguinal hernia without any difficulty. The limitation is not so much one of age as one of uncontrollability. An adult may be uncontrollable as well as a child.

Almost any operation may be done on the lower extremity by blocking the sciatic at its exit from the pelvis, or at the gluteal fold and the anterior crural at Poupart's ligament. If the operation is in the region supplied by the lesser sciatic, or the external cutaneous, these nerves likewise must be blocked. The upper extremity may be operated on by blocking the brachial plexus at the root of the neck, or for operations on the forearm or hand the nerve trunks can be easily reached in the arm. The superficial cervical plexus is blocked for operations on the neck, and there is nothing more satisfactory than an operation for goiter under nerve-blocking. Operations on the face, tongue, and scalp can be done, and I have trephined twice, both patients expressing themselves as suffering no pain.

The complete operation for the removal of the breast and axilla can be done by blocking the brachial plexus, the acrominal and clavicular branches of the superficial cervical plexus, and from four to six of the intercostal nerves.

The method is ideal for hernias, as the region is so easily blocked by injecting the ilio-hypogastric and the ilio-inguinal nerves near the anterior superior spine of the ilium. One of the most satisfactory regions to block is the perineum, including everything from the sacrum behind to the symphysis in front in either sex. This region is blocked by injecting into the sacral canal. A needle about 10 to 12 cm. in length is introduced into the sacral canal through the open space between the sacrum and the coccyx. This space is closed with a dense ligamentous structure which is readily recognized as soon as the needle touches it. The patient is placed on the right side with the limbs sharply flexed. With a fine hypodermic the skin and subcutaneous tissue are injected so there will be no pain on passing the larger needle. The long large needle is then introduced, detached from the syringe at an angle of about 45 degrees with the surface of the body at that point. The needle is introduced into the sacral canal a distance of from 5 to 7 cm. One should now wait a few seconds to see that no blood or cerebropsinal fluid escapes from the needle; the one indicating that the point of the needle is probably in one of the larger veins surrounding the cauda; the other that the needle has punctured the lower end of the sac of the central spinal canal. In either case the fluid should not be injected until the point of the needle has been changed to another location. The spinal sac usually ends at about the upper edge of the third sacral vertebra. When the needle is in the proper place, from 30 to 40 ccm. of a 1 per cent solution, containing from ¼ to ½ of 1 per

cent of calcium chloride, is introduced slowly. Anæsthesia begins in a few minutes and extends from behind forward. It requires as a rule from twenty to thirty minutes for the anæsthesia to be complete. Occasionally I have found that the amount first injected was insufficient to produce complete anæsthesia, so now I do not withdraw the needle at once but allow it to remain *in situ*, and if on testing the part at the end of ten or fifteen minutes it seems that the anæsthesia is not going to be complete 10 or 15 ccm. more of the fluid may be injected. In this way complete anæsthesia can always be produced. Under this anæsthesia any operation on the lower bowel, perineum, vagina, vulva, urethra, cervix, prostate, etc., may be performed without a particle of pain.

By regulating the amount of fluid injected the anæsthesia may be made to include the entire sacral plexus.

For operations on the kidney, the eleventh and twelfth dorsal and the first lumbar nerves are blocked as they escape from the intervertebral foramina. The abdominal wall may be blocked at any point so that the cavity may be opened painlessly. Any operation within the cavity may be done which does not draw on the mesentery or other peritoneal folds or ligaments, or which does not involve the unblocked parietal peritoneum anteriorly or posteriorly. So long as the manipulations are limited to those organs which are insensitive, no pain is experienced. Packing off the intestines from the pelvis or other region necessarily draws the mesentery and the packing comes in contact with unblocked parietal peritoneum; hence, pain is produced. Therefore, in operations involving the painful parts mentioned, my plan is to open the cavity under nerve-blocking, then give the patient a little nitrous oxide gas and oxygen during those manipulations which are known to be painful. As soon as this part of the operation is finished, the gas is discontinued and the operation completed under the nerve-blocking. Following this method many of the cases receive no general anæsthetic, some receive a little gas, and all are awake and conscious long before leaving the table and throughout a large part of the operation.

Any method of producing anæsthesia for surgical purposes, if more or less new, must possess some advantages over old and well-established methods if it is to gain general recognition. The question, therefore, at once arises, What advantages has nerve-blocking over general anæsthesia as produced to-day?

In the first place it is less dangerous. It will be admitted that practically all substances used for this purpose are more or less toxic, but the degree of toxicity is comparatively well known and as the substances are injected locally to affect nerve-trunks and not used generally to affect nerve-centers, it is easier to guard against an overdose. The method is devoid of the dangerous and unpleasant complications which so frequently follow the use of general anæsthesia, particularly ether and chloroform, such as pulmonary irritation, pneumonia, nephritis, suppression of the urine, acidosis, nausea, vomiting, headache, gaseous distention of the stomach, etc. Patients recover from the effects of the anæsthetic much quicker; in fact, they frequently are able to take, and often ask for, drink or light nourishment on reaching their room. Without wishing at this time to enter into a discussion of the nature and cause of shock, it may be said that if the blocking is complete no shock whatever follows operations done by this method, save that due to loss of blood; for without afferent impulses no shock follows injury.

The presence of consciousness is no disadvantage; in fact, it is frequently of great advantage to have the patient conscious. In my experience, the great majority of patients prefer being conscious and look upon the loss of consciousness as one of the greatest drawbacks to an operation. The psychic element in these cases has been greatly overestimated. The horror of an operation is based on, first, the fear of pain; second, the loss of consciousness; and third, apprehension as to the outcome. The assurance that there will be no pain eliminates the first element. The fact that consciousness is not lost eliminates the second. The third element, or apprehension as to the outcome, is present just the same whether the patient be conscious

or unconscious. I have found, however, that patients are inclined to look upon operations that can be done without the loss of consciousness under nerve-blocking as less severe than when a general anæsthetic has to be used.

One other thing in favor of nerve-blocking is that it teaches the surgeon to be more gentle and more considerate of the patient.

It is surprising what can be done in the abdomen, for instance, by being gentle without producing pain; and there is no doubt that the less tissues and organs are mauled about, the less shock there is, whether the patient be conscious or unconscious.

It is desirable in many cases to give a hypodermic of morphine and atropine or scopolamine about three-quarters of an hour before the operation, as it quiets the patient and relieves the irksomeness of lying still in one position so long.

During the past few months I have done under nerve-blocking two hundred and thirty-four operations on two hundred and seventeen patients. The following list shows the wide applicability of the method.

OPERATIONS

| | |
|---|---|
| Angioma venous | 1 |
| Amputations | |
| Breast | 7 |
| Leg | 5 |
| Foot | 1 |
| Scrotum | 1 |
| Adenitis | |
| Cervical | 5 |
| Inguinal | 2 |
| Appendectomy | 34 |
| Adhesions | |
| Abdominal | 5 |
| Duodenal | 2 |
| Cysts | |
| Cheek | 1 |
| Ovary | 5 |
| Breast | 3 |
| Cystocele | 2 |
| Colostomy | 1 |
| Carbuncle, neck | 2 |
| Cervical rib | 2 |
| Cirrhosis liver (Talma's operation) | 1 |
| Decompression operation skull | 1 |
| Epithelioma | |
| Lip | 2 |
| Inguinal region | 1 |
| Exostosis, os calcis both | 2 |
| Fractures | |
| Plate | 1 |
| Reduction | 3 |
| Fistula | |
| Rectal | 9 |
| Appendiceal | 1 |
| Gastrostomy | 1 |
| Gastro-enterostomy | 1 |
| Hernia | |
| Inguinal | 34 |
| Femoral | 1 |
| Ventral | 3 |
| Hæmorrhoidectomy | 14 |
| Hydrocele | 3 |
| Hysterectomy | 6 |
| Ileocolostomy | 1 |
| Intestinal obstruction | 2 |
| Kidney fixation | 4 |
| Osteomyelitis, leg | 2 |
| Polypi | |
| Rectal | 1 |
| Cervical | 1 |
| Urethral | 1 |
| Perineal section | 2 |
| Prostatitis (drain) | 1 |
| Perineorrhaphy | 4 |
| Peroneal nerve sutured | 1 |
| Ptosis, eye lid | 1 |
| Rectocele | 1 |
| Rupture patellar ligament | 1 |
| Resection rib | 2 |
| Submucous fibroid via vagina | 1 |
| Subphrenic abscess | 1 |
| Stone | |
| Kidney | 1 |
| Ureter | 1 |
| Bladder urinary | 2 |
| Bladder gall | 3 |
| Scar Tissue | |
| Finger | 1 |
| Neck and chin | 1 |
| Sphincter (rectal) dilatation | 1 |
| Thyroidectomy | 13 |
| Trachelorrhaphy | 1 |
| Ulcers, rectal | 1 |
| Uterus fixation | 3 |
| Varicocele | 3 |
| Tumors | |
| Intestine | 1 |
| Abdominal wall | 3 |
| Urinary bladder | 1 |
| Cystostomy (suprapubic) | 2 |
| Anæsthesia for other operators | 3 |
| Number of patients operated on | 217 |
| Number of operations performed | 234 |
| Number of failures | 6 |
| Number of cases in which gas was used in addition to blocking | 27 |

There were seven deaths; two due to hyperthyroidism; two to uræmia, following prostatectomy; one to delirium tremens; one to acute dilatation of stomach on the fifth day, and one on the seventh day following extensive removal of the cæcum and ascending colon for carcinoma.

# PATHOLOGY AND TREATMENT OF ACUTE INFECTIOUS (METASTATIC) ARTHRITIS

## With a Description of J. B. Murphy's Formalin and Glycerin Injection Method

By FRED C. ZAPFFE, M.D., F.A.C.S., Chicago

THE treatment of the acute arthritides involves a definite plan of procedure, one which is based on the pathology present in these cases. The exciting factor may be a variable one, but the results of its activity are always the same; i.e., the clinical picture varies with the cause, the pathologic picture never. Dr. J. B. Murphy's dictum, pronounced with so much emphasis on many occasions, namely, that "*every type of non-traumatic joint infection is a metastatic manifestation of a primary infection in some-other part of the body*," is sound because it is based on pathologic principles, and may therefore be accepted as being strictly in accord with the clinical picture of these cases. Disbelief in an "idiopathic," rheumatic, or dietetic arthri is is confirmed and strengthened by extended clinical observation. In the very nature of things, such a condition as an idiopathic non-traumatic arthritis is a pathologic impossibility. Extended observations, both experimental and clinical, in the Murphy service at Mercy Hospital bear out the correctness of this statement.

These arthritides are always of bacterial origin primarily, although bacteria may be and usually are absent from within the joint-cavity early in the disease process, a fact which has led to errors in treatment. For example, in cases of gonorrhœal arthritis, the gonococcus is not found in the joint-fluid or effusion in from 20 to 93 per cent of the cases, depending on the time which has elapsed between the appearance of the synovitis and the date of the aspiration. The inflammatory fluid appears in the joint-cavity long before the gonococcus makes its way through the synovial mesothelial layer of the joint-membranes into the free joint-cavity. The retention of the bacterium, which is responsible for the arthritis, in the vascular and the submesothelial layers of the synovial membrane, accounts for the early negative bacterial findings in the fluid aspirated from the joint in so many of these arthritides. It is not primarily a surface infection of the synovial membrane, but an intramural one.

Further, in a fairly large number of these cases the original source or focus of the infection cannot be ascertained, although that fact does not preclude the existence of such a focus. Such cases have been termed "idiopathic" arthritis or "cryptogenetic" arthritis. If these patients are examined carefully, and are subjected to the various serologic tests now employed by all careful observers, the original focus of infection of which the arthritis is a metastatic manifestation may be located. It is evident, then, that in order to treat these cases accurately and effectively, it is absolutely necessary to ascertain the etiologic factor, to counteract its influence by a vaccine, and, if possible, to eradicate it from the body entirely.

### TIME OF METASTASIS

The time of occurrence of an arthritis following an infectious disease, or a metastasis of an infection elsewhere in the body, is often of value as a means of determining the nature of the particular exciting cause in a given case. For instance, gonorrhœal arthritis practically always makes its appearance in eighteen to twenty days after the first appearance of the discharge. The arthritides following scarlet fever usually appear from the eleventh to the sixteenth day after the onset of the initial symptoms of the disease; i.e., during early convalescence. The arthritis follows rather closely on the heels of the disappearing acute symptoms, so much so that it apparently merely represents another stage of the disease, when in fact it is a sequel. These arthritides are all of streptococcic origin. This period of onset corresponds with many of the original infections produced by non-identified organisms.

Standing out in sharp contrast with the arthritides just mentioned are the very late manifestations of bone and joint involvement occurring as the result of a previous typhoid infection. They may occur as early as the fourth week and rarely appear later than the eighth week. They appear just about the time when it is believed that the intestinal ulcers must have healed.

The arthritides complicating pneumonia, as a rule, appear during the second week of the disease; that is, from the tenth to the fourteenth day. Arthritis of pneumococcus origin rarely makes its appearance before the crisis. The streptococcic arthritides always appear much earlier than do those of pneumococcic, gonorrhœal, or typhoid origin; they are much more severe in their clinical course and manifestations, and are very much more difficult to manage in their fulminating stage. The non-streptococcic group of joint infections, as stated, do not occur early in the course of the disease, but sometime during the period of convalescence or recrudescence of the active pathologic process, when one would expect that, as the primary lesion had apparently healed, no further trouble was to be apprehended.

Another clinical observation of value in determining the etiologic factor in these cases is the fact that in most cases the metastasis in the joint, or the localization of infective micro-organisms in the joint, can be connected or associated with (1) trauma, or (2) exposure, as (a) wetting of the feet; (b) chilling of the surface of the body; (c) overexertion, and (d) fatigue. When looked for carefully, such an association is rarely found to be absent. The joint involved has either been subjected to repeated traumas, slight in severity and not immediately productive of subjective or objective symptoms, or the patient has sustained one severe trauma, which has left an indelible mark in the tissues of the joint traumatized, and has laid these tissues open to subsequent infection. These traumas may be recent or remote. When exposure has been operative as an etiologic factor, in connection with the lodgment of infective micro-organisms in the joint-tissue, it is always a recent affair.

The point which I wish to make at this time, and which I desire to emphasize, is *that the infective micro-organisms in the cases now under discussion have been present in the body before the trauma occurred; that they have lain dormant for a long or short period of time.* Under the conditions mentioned as favoring the development of virulence, for the assumption of activity, they have lodged in the joint by metastasis, producing a typical infective arthritis. Therefore, as pointed out by Dr. Murphy, the term "rheumatism" is a misnomer, because it fails to stand the test of pathologic nomenclature; it fails to indicate in any way the nature of the pathologic process present in these joint inflammations. The arthritis produced in this manner is not "rheumatism." It is a definite pathologic process, a typical, metastatic infectious process, even though the original focus of the infection may go undiscovered.

In the traumatic infections we must distinguish between two types of cases: (a) the cases in which the infective micro-organisms are admitted directly to the surface of the synovial membrane or into the joint-cavity by penetration of the joint—a traumatic, direct infectious arthritis; and (b) the cases in which the joint is not punctured or laid open, and in which the trauma merely serves to localize in the joint an infection which is already present elsewhere in the body—a metastatic hæmatogenous arthritis.

The second group is the one with which we are at this time more particularly concerned. However, I do not wish to miss the opportunity to say just a few words on the treatment of these traumatic infections.

### TRAUMATIC ARTHRITIS

The pathologic micro-organisms which are admitted into the joint at the time of its penetration will excite a local infection and will eventually destroy the mesothelial cells which protect or cover the synovial membrane —if these cells have not already been destroyed by the trauma. In the joint which is untreated or which is treated improperly, the infective products always destroy this synovial mesothelium; and then, but not until then, do the bacteria make their way into the

submesothelial lymph-channels, and into the tissues outside of the joint. If these mesothelial cells are not destroyed, if the surface of the synovial membrane remains smooth and normal in its structure, the bacteria remain in the joint without effecting any tissue changes, and eventually become avirulent. Therefore, on the basis of the pathologic process involved in these cases, the indications for treatment are (1) to prevent the destruction of the synovial mesothelium, and (2) to remove the infectious material from the joint or *to render it innocuous*.

This is done by (1) closing the joint capsule with fine plain catgut, approximating the synovial surfaces as accurately as possible by making an ectropion of the cut edges, and without drainage of the joint-cavity, but draining the subcutaneous cellular tissue down to the joint capsule; (2) immediately injecting the joint with a 2 per cent solution of liquor formaldehyde in glycerin (a procedure which will be described in detail later), and (3) applying a Buck's extension.

The joint may be aspirated and again injected with this formalin and glycerin mixture within twenty-four hours, if the tension in the joint is great or if the patient's temperature is rising even without any increase in tension in the joint. The aspiration and injection may be repeated in two, three, or four days, depending on the constitutional manifestations and the clinical course of the joint lesion.

These injections are made as often as is necessary. The procedure, when carried out as it should be, has been followed with good results, so that it is the established method of treatment in all these cases in our clinic. As a rule, two or three injections suffice to sterilize the joint-cavity completely. Aside from the aspiration and injection of these joints, the essential feature of the treatment is that *the joint-cavity is not drained*. In any synovial-lined cavity that is exposed to the air for a considerable period of time, the mesothelial cells are destroyed, fibrous synechiæ form, or possibly even a bony ankylosis. Therefore, drainage of a joint is to be avoided, if possible. The treatment outlined above should be instituted immediately after the occurrence of the injury if the best results are to be obtained. It must be understood, and I wish to emphasize this point, that if any of the joint structures have been destroyed before the treatment is instituted, the injection into the joint of formalin and glycerin, or of anything else, will not restore the integrity of destroyed tissues; in other words, it will not cause regeneration of tissue. This particular mixture merely neutralizes, as it were, the infective products, the poisons, and destroys the virulence of the bacteria, thus preventing the further destruction of tissue. That becomes a very essential matter when it is borne in mind that ankylosis frequently is a sequence of this type of lesion

### METASTATIC ARTHRITIS

The second group of cases of arthritides, the cases of hæmatogenous or metastatic origin, includes the cases in which one or more joints may be involved, either simultaneously or successively. The arthritis is usually initiated by a chill or severe chilly feelings, and is commonly followed by diffuse pains in the muscles, bones, and joints. In from twelve to thirty-six hours after the chill, the process, as a rule, localizes itself in one joint, sometimes in several joints. The clinical evidence of this metastasis is a sudden severe pain and effusion in the joint affected, tenderness to touch, swelling, and loss of motion or restricted motion because of the pain.

These patients usually give a very definite clinical history, one which portrays the successive steps of the lesion in the order of their appearance, resembling the so-called syndrome of symptoms described as occurring in some other pathologic processes. These symptoms occur so regularly and in so definite an order that they may well be termed a syndrome. It is a clinical observation that ankylosis often is the final process in these cases of arthritis, particularly when the lesion is initiated by a chill; therefore, the initial chill should be accepted as a distinct warning of the final result. This point cannot be emphasized sufficiently often nor too strongly. The micro-organisms concerned in the production of these acute arthritides are all of

the most virulent type. They destroy the synovial membrane covering quickly, and lead to ankylosis unless the case is seen early and managed properly.

The multiple or polyarticular types of infection are rarely initiated with a chill, and ankylosis seldom results. The condition is caused by less virulent varieties of bacteria, the clinical course is less acute, it is of shorter duration, and the joint is apparently left in as good condition as it was before the onset of the trouble. There is, however, a class of cases of multiple arthritis in which the infecting micro-organisms are intensely virulent. The chill occurs early and is severe in degree. The clinical course of the process is very acute, rapidly progressive, and may, in fact often does, terminate in ankylosis of many joints, involving, for instance, the hips, knees, ankles, elbows, fingers, jaws, and even the spine. Fortunately, these cases are few.

Needless to say, the immediate treatment of these cases is not only difficult, but it is very unsatisfactory, although it should not be regarded as entirely discouraging. The multiplicity of the joints involved makes it impracticable to apply extension to every joint, but it may and should be applied to the larger joints, such as the hips, knees, elbows, ankles, and wrists, leaving the treatment of the smaller joints for a subsequent time. The treatment is identical with that to be employed in the mono-articular type of disease, because the constitutional reaction to the injection of a few joints materially benefits the joints that are not injected.

While this is not the time to discuss the vaccine treatment of these cases, it is rapidly becoming the most valuable treatment of multiple arthritis of the so-called "rheumatic" type. The autogenous vaccines are to be preferred; yet if such a vaccine cannot be obtained, appropriate stock vaccines, mixed vaccines freshly prepared, should be used.

Following the infection of these joints is noted first a synovitis, which Murphy has classified as follows: (a) Simple, serous, non-suppurating; (b) fibroid, infiltrating, cicatrizing, ankylosing; (c) rheumatoid, absorbing, infiltrating, osteoplastic, periarticular, ossifying; (d) suppurative; (e) tuberculous, luetic, etc. The simple, serous, non-suppurating type is caused by metastases from acute infections elsewhere in the body, such as an acute pharyngitis, an accessory nasal sinus infection, tonsillitis, gastro-intestinal disorders, genito-urinary diseases, influenza, etc. The destructive, ankylosing type follows in the wake of the former when the infections are of the superlative degree. The fibroid, infiltrating, cicatrizing variety occurs with the low-grade infections coming from the alveolar processes, teeth, tonsils, pharynx, large intestine, gall-bladder, etc. The colon bacillus is found to be the exciting cause more often than any other organism. The so-called rheumatoid joints are the metastatic manifestations of chronic infections, located in the alveolar processes, post-nasal accessory sinuses, tonsils, pharynx, genito-urinary tract, etc.

### INDICATIONS FOR TREATMENT

The indications for treatment are: (a) To relieve the patient of pain; (b) to prevent the destruction of tissue and subsequent deformity or ankylosis of the joint; (c) to preserve the function of the joint.

The plan of treatment first outlined by Dr. J. B. Murphy many years ago, and which is employed in his service in Mercy Hospital at the present time, consists of the following steps:

1. *The relief of intra-articular tension by aspiration.* Much of the pain in the joint from which these patients suffer is caused by the increased tension in the joint-cavity produced by the accumulation of fluid and infective products. This is easily and quickly relieved by aspiration. In general, the procedure is as follows: The skin at the site of the puncture wound is painted with tincture of iodine, and then, under gas or local anæsthesia, it is punctured with a tenotome. Next the needle (short bevel) of an aspirating syringe is carefully introduced into the joint. In the case of the knee, the puncture is made one inch above and one inch to the outer side of the patella. The needle is directed through the subcutaneous tissues, then under the patella, and on into the joint. In all other joints, the needle enters the joint at

the nearest, most available point. Traction should be made distal to the joint, so as to separate its component articular surfaces as much as possible. Care should be taken to avoid injuring the velvety surface of the synovial membrane, because, as pointed out above, if the lining mesothelial cells are abraded or injured so that they die and drop off from the submesothelial tissues, the synovial membrane is deprived of its protection and resistance against infective products in the joint-cavity, and an ankylosis may result or the infection within the joint is allowed to spread to the periarticular structures, perhaps causing their destruction. Therefore the needle should be introduced slowly and directly without any unnecessary manipulation. By making negative pressure on the syringe piston, one can very readily and quickly determine whether or not the needle is in the joint-cavity. If it is, the joint-fluid will flow into the syringe; if it is not, nothing will appear in the syringe. A heavy screw syringe must be used to make these injections, because the thick formalin and glycerin mixture cannot be forced out into the joint with the ordinary syringe. Plugging of the needle by bits of tissue or thick exudates will also prevent any fluid from appearing in the syringe barrel. In such cases a larger needle must be used.

Opening the joint and draining it, which unfortunately is a procedure still employed, very quickly relieves the tension, but experience has shown that such drainage is followed by ankylosis of the joint in over 96 per cent of the cases. Therefore, the treatment of these suppurating arthritides by means of joint drainage is contra-indicated. Additional pathologic organisms from without are admitted into the joint when it is opened and drained for any considerable length of time. The joint may be opened and the accumulated infective products removed, but the opening must be closed immediately and without drainage. Relieve the tension in the joint by aspiration. The uniformly good results obtained by us recommends the procedure as the proper one for the treatment of these cases. It is based on pathologic principles as well as on clinical experience.

2. *Relief of intra-articular pressure, the result of involuntary contraction of the muscles around the joint.* This contraction forces the articular ends of the inflamed joint surfaces together and causes most excruciating pain. The patients state that it feels as though the joint was being jammed together. This pain is relieved very quickly by putting a Buck's extension on the limb below the joint, attaching to it a weight sufficiently heavy to overcome the muscular contraction. In some cases five pounds is sufficient, but, as a rule, fifteen to twenty pounds must be used, and if the patient is very muscular, from thirty to forty pounds, or even more, should be used. The extension most effectively separates the articular surfaces, overcomes muscular contraction, corrects malpositions of the limb, and prevents destruction of tissue and ankylosis, with or without deformity. This extension should be applied *immediately*, as soon as the patient seeks medical advice, no matter what the type of arthritis may be. The extension may not always prevent the ankylosis, but it *always* prevents deformity. The Buck's extension is applied as in fractures. In the case of the knee, care must be taken to place the adhesive below the head of the fibula, so that it will not make pressure on the external popliteal nerve, because such a trauma may be followed by paralysis of this nerve, and consequent drop-foot. This extension is left on as long as is necessary, weeks or even months, until every evidence of disease in the joint has subsided; that is, until the temperature is normal and joint motion is free and unrestricted and absolutely unaccompanied by pain.

### USE OF FORMALIN AND GLYCERIN MIXTURE

3. *Neutralization of the infection in the joint and the production of a local immunity.* This is the most important step in the procedure. It was for this purpose that Dr. Murphy, in 1900, first recommended the use of a 2 per cent solution of liquor formaldehyde in glycerin, and the results he and others have obtained from the proper use of this solution in many hundreds of cases have been so good that the treatment of any case of acute in-

fective or chronic arthritis should be considered incomplete without resorting to the method as practiced by Dr. Murphy.

The effect of this mixture in the joint is fourfold:

*First.* It renders the fluid in the joint a poor culture medium.

*Second.* It induces an increased polynuclear leucocytosis.

*Third.* The lymph spaces in the neighboring tissue are cofferdammed by infiltration with these leucocytes, so that the infection is localized in the joint. The polynuclear leucocytosis in the joint-fluid gives up a trypsin ferment, which converts the albuminous substances into peptones, thus rendering them more easily absorbable and increasing phagocytic action many times.

*Fourth.* A constitutional or general leucocytosis is also produced.

The method of injection is as follows: The same needle which was used to aspirate the fluid from the joint is employed to make the injection. It is an ordinary aspirating needle, of large caliber, with a short bevel. After the fluid in the joint has been aspirated, the syringe containing it is detached from the needle, which is held securely by an assistant with a hæmostat, and a strong screw syringe containing the formalin and glycerin solution is attached to the needle. As it is very difficult to force this mixture into the joint, only a screw syringe can be used.

The solution used is a 2 per cent solution of liquor formaldehyde (made from the commercial article, a forty per cent aqueous solution, in glycerin, ten drops of formalin to two ounces of glycerin). It must have been mixed *at least* twenty-four hours before it is used, *although it may be older.* It should be shaken frequently. *Never use a mixture that is not at least twenty-four hours old.* The quantity injected varies with the joint affected. For instance, fifteen to twenty ccm. are injected into the knee-joint; five to seven ccm. into the wrist, elbow, and shoulder joints, and one to two ccm. into the smaller joints.

The injection is always made with the patient asleep under gas anæsthesia. Never attempt to inject the joint otherwise—and the patient must remain in bed. Injection in the office is wrong, and bad practice. The joint is manipulated freely immediately after the injection is made and the needle withdrawn, so as to disseminate the fluid in the joint. The opening is sealed with cotton and collodion, and the Buck's extension is applied before the patient awakes. The injection should be repeated as often as is necessary, until the patient is free from pain and the temperature remains normal. The patient may complain of great pain for a day or two after the injection, and this should be relieved by administering heroin, 1/10 to 1/8 grain, every four hours, if necessary. The application of ice or cold packs to the joint also gives great relief and exerts a favorable influence in checking the disease process in the joint.

Subsequent injections are made in the same manner, except that it is not always necessary to aspirate fluid from the joint. It should be emphasized that before injecting the formalin and glycerin mixture, negative pressure is made on the syringe, to determine whether the needle is in the joint-cavity, and to estimate from the appearance of the fluid the degree of reaction in the joint resulting from the previous injection. This joint fluid is bloody if the reaction has been a favorable one. The fluid rises to the top of the mixture in the syringe, so that when the joint is injected only the injection solution enters the joint.

The various steps in this procedure are each of equal importance, and each one must be carried out with painstaking care and promptness. Aspiration, injection, extension and rest is the order of procedure, and none of these steps can or should be omitted. The patient is not permitted to use the joint until every evidence of inflammation has subsided.

The use of vaccines, preferably of the autogenous type, is always followed by splendid results in these cases, and should be employed in every case in which their use is possible. They are continued until there is no longer any reaction to their injection.

# ACUTE HÆMORRHAGIC PANCREATITIS[1]

## With a Clinical Report of Eight Cases

By WILLIAM LINDER, M.D., F.A.C.S., Brooklyn
Attending Surgeon, Jewish Hospital

MANY epoch-making discoveries in the pathology of a number of diseases may be directly attributed to the great progress made in modern aseptic abdominal surgery; and many conditions which had heretofore been practically unknown or but imperfectly understood have now been placed on a sound surgical basis. The opportunity to study the "living pathology," as it has been termed, has revolutionized our former conceptions of some of the diseases incident to the region of the upper abdomen; and among these, acute affections of the pancreas hold a very conspicuous place. To illustrate: In 1894, when Professor Körte, of Berlin, presented before the German Surgical Society his first paper on acute hæmorrhagic pancreatitis, there was hardly any discussion, so little was then known about this disease. At present, however, a great deal of progress has been made in the study of the acute diseases of this interesting organ, and considerable literature has since accumulated on this subject; and as a result of this, acute hæmorrhagic pancreatitis is no longer regarded as a rare surgical curiosity, but is frequently recognized at the operating table, and, in many cases, it has even been diagnosed before operation.

*Etiology.* Acute hæmorrhagic pancreatitis is common to both sexes and may occur at any age, though statistics show it to be more frequent among males. In my series of eight cases, however, there was only one male. Both alcohol and syphilis are said to be very potent predisposing factors. Obesity, cholelithiasis, and parturition have also been mentioned as elements favoring the development of acute pancreatitis. The youngest patient in Körte's series was sixteen years old, and the oldest seventy. In my own series, the youngest was nineteen and the oldest sixty-five. It occurs most frequently, however, in the fourth and fifth decades.

The anatomical arrangement of the ducts of the pancreas and those of the biliary system, together with their proximity and relationship to the intestinal tract, predispose the pancreas to frequent infections. It has been shown that a stone lodged in the ampulla of Vater may cause a damming back of bile into the pancreatic duct. Flexner has proved experimentally that, by injecting bile into the duct of Wirsung, he was able to produce an acute pancreatitis with characteristic fat-necrosis. Gulecke, in like manner, produced an acute pancreatitis by injecting bile, blood, or oil into the pancreatic ducts. Clinically, again, acute hæmorrhagic pancreatitis has frequently been found associated with gallstones in the biliary passages. The experimental work of Dauerbauer, Gulecke, and von Bergman has further shown that, in acute pancreatitis, the free outpouring of the glandular secretion and the absorption of this material, especially when autolysis of the gland itself takes place, are responsible for the profound toxæmia with which these patients are afflicted, and the absorption of these toxins is frequently the cause of death.

*Pathological anatomy.* The first contribution on the pathology of acute hæmorrhagic pancreatitis is credited to Fitz, who, in 1889, published an extensive monograph on this subject; and it seems that very little has been added to Fitz's classic description in which he classified acute pancreatitis into three varieties: the hæmorrhagic, the gangrenous, and the suppurative pancreatitis. In the acute hæmorrhagic pancreatitis the pancreas is swollen and enlarged, and its interstitial tissue, as well as the tissue in its neighborhood, is infiltrated with blood and serum. Microscopic examination shows the presence of cellular and fibrinous exudate with necrosis of the parenchyma. In the fat of the omentum and of the subperitoneal tissue are the disseminated foci of necrosis to which Balser has called

[1] Read before the Brooklyn Surgical Society, May 7, 1914.

attention and which has since been known as "fat-necrosis."

Gangrenous pancreatitis, though it may follow other conditions, is usually the result of an acute hæmorrhagic pancreatitis; and, in at least half of the recorded cases, evidence of previous hæmorrhage is present in the altered gland. The organ is enlarged, often soft and friable, and of a color which varies from mottled red and gray to dark brown or black. By extension of the gangrenous process to the tissues about the organ, almost complete sequestration may result. In some cases the completely sequestrated pancreas, attached by only a few shreds of tissue, is surrounded by purulent fluid. Communication may be formed with the intestines, and in two cases described by Chiari a large mass of necrotic material discharged by the rectum was recognized as gangrenous pancreatic tissue.

The clinical symptoms of both the acute hæmorrhagic and the gangrenous pancreatitis resemble one another very closely. But when the pancreas is found to be gangrenous, the illness has been of longer duration, proving fatal at the end of several weeks.

Suppurative pancreatitis resembles suppurative inflammation of other organs. The gland is enlarged and may contain abscess cavities of various sizes, and the peripancreatic tissue is indurated. This type rarely pursues an acute course, but persists for weeks and months and the abscess cavities may discharge into the stomach or duodenum, or, rupturing into the lesser peritoneal cavity, may form here a pus-collection of large size. Fitz has pointed out that the disseminated fat-necrosis is uncommon with suppurative pancreatitis, though always constantly found in association with the hæmorrhagic and gangrenous lesions.

The lesion usually described as acute hæmorrhagic pancreatitis has not the character of an inflammatory process. Widespread necrosis of pancreatic parenchyma is primary, and such inflammatory changes as occur are found only at the margin of the necrotic tissue. Similar lesions do not occur in any other organ, save perhaps in the stomach, where an impaired vitality of the mucosa is followed by necrosis and subsequent ulceration, often with hæmorrhage brought about by the action of the gastric juice upon the injured tissue. The analogy is significant, for the pancreas too contains an active proteolytic enzyme which, unrestrained, is capable of destroying tissue. The peculiar necrosis which affects the parenchyma of the pancreas is no doubt due to the trypsin, while the necrosis of fat is caused by the other enzyme, the steapsin.

While it has been customary to describe the above diseases as separate entities, it is more than likely that they simply represent different stages of the same disease. In mild cases of acute hæmorrhagic pancreatitis the hæmorrhagic effusion is slight, and it is possible for resolution to take place with a complete recovery. But if the hæmorrhage is more extensive, the process may go on to either a subacute or chronic inflammation, or an intense reaction takes place with rapid and extensive destruction of the gland tissue.

Hæmorrhages into the pancreas occurring in an individual previously supposed to be in good health may be the only lesion found to explain the fatal termination of an illness lasting only a few hours. The literature contains numerous examples of so-called pancreatic apoplexy, of which the sudden onset and rapidly fatal end suggest an analogy with the more frequent cerebral hæmorrhage. The quantity of blood escaping from the vessel does not bear any direct relation to the severity of the lesion.

*Symptomatology.* The symptoms of acute hæmorrhagic pancreatitis are not always definite and clear-cut; but in a certain number of cases, the picture is so characteristic that at least a tentative diagnosis can be made if the condition be borne in mind. The patient is usually in good health when he or she is suddenly seized with sharp, severe pain in the epigastric region, accompanied by vomiting and followed by rapid development of collapse. In some cases there is a history of occasional attacks of some gastric disturbance or of attacks suggestive of gall-stone colic. The pain is very intense and may radiate to the back, and is described by some patients as severe "splitting backache."

Cyanosis has been a feature in many cases, especially over the abdomen. The temperature, as a rule, is not elevated; in fact, in many cases it is subnormal, depending upon the amount of shock the patient is in. Constipation is usually very marked. Upon examination, one finds a distended abdomen with marked tenderness in the midepigrastrium and to the left, and sometimes exquisite sensitiveness in the left lumbar region.

Of course, all these symptoms in themselves are not pathognomic, but a careful analysis of the history of the case, the mode of onset, and the other phenomena, as they present themselves, will frequently help in establishing the correct diagnosis. The pain in acute hæmorrhagic pancreatitis is much more severe than in any other acute abdominal condition and is not so readily relieved by the usual dose of morphine. This pain, with its radiation to the left lumbar region and the peculiar "backache," is more suggestive of acute pancreatitis than any other upper abdominal condition. The vomiting in acute pancreatitis, in contrast with intestinal obstruction, is relieved by lavage, whereas in obstruction the stomach is constantly filling up again. Collapse and lividity are striking features in the very severe cases. These, in conjunction with the rapid shallow breathing, I have found in no other condition except perforated gastric or duodenal ulcers. The latter, however, can be differentiated from acute pancreatitis by the fact that in perforation there is no abdominal distention or tympanites, but on the contrary the abdomen is retracted or boat-shaped, and there develops a peculiar boardlike rigidity with absence of liver dullness; and with a previous history pointing to gastric or duodenal ulcer, the diagnosis is fairly clear. The temperature in perforations is always elevated, due to the spreading infection, while in acute pancreatitis the temperature is more apt to be normal or subnormal, the process being local for a time at least.

Now, in spite of all that has been said, it is sometimes impossible to make a differential diagnosis from other upper abdominal conditions before operation; but, since all acute upper abdominal conditions require immediate surgical intervention, one should not hesitate to explore the abdomen. Again, if the surgeon would bear in mind the possibility of acute pancreatitis with its symptom-complex, as outlined above, I believe that a tentative diagnosis before operation will be made much more frequently. Thus it was my good fortune, several months ago, to see a case in consultation, in which I ventured the diagnosis of acute hæmorrhagic pancreatitis, where a malignancy in the splenic flexure was suspected. The symptoms, as presented, simulated an acute intestinal obstruction. The following is a report of the case.

Mrs. C. J., age 65, admitted to the Jewish Hospital, February 11, 1914. She was married and the mother of a number of children; she had passed her menopause without disturbance and had always enjoyed good health. She was taken suddenly ill two days before, after a midday meal in a restaurant. She vomited, had severe epigastric pain, became markedly prostrated, and was constipated. Under treatment of family physician, she did not improve.

*Present condition.* Patient was a large obese woman and looked very ill; pulse rapid, bad cardiac action, cyanotic, great abdominal distention, marked pain and tenderness in midepigastrium and to the left. Distinct tenderness elicited in the left lumbar region. A diagnosis of probable acute hæmorrhagic pancreatitis was made and the patient was at once sent to the hospital. Patient was still suffering from shock and, owing to her myocardial condition, operation was postponed until the next day.

*Operation*, February 12, 1914. Anoci anæsthesia. High median incision; serosanguineous fluid in the abdomen; spots of fat-necrosis on omentum. Gastrohepatic omentum incised and a large quantity of hæmorrhagic fluid liberated from the retroperitoneal space. The pancreas was found enlarged and swollen from head to tail. The gall-bladder was distended. With blunt forceps the pancreas was punctured in many places. Rubber-tube-and-gauze drainage introduced rapidly and omentum closed around tube. The gall-bladder was not disturbed on account of the patient's poor general condition.

Unfortunately, the patient did not react well. Cardiac action became embarrassed, with cyanosis of face and extremities, dyspnœa and weakness. She finally developed pulmonary œdema, and expired on the second day after operation.

Here we had a case in which the characteristic symptoms were very suggestive; namely, the suddenness of the onset, the peculiar pain localized in the epigastrium and to the left, cyanosis, marked prostration and paresis of the bowel; and all this practically summarizes the entire symptom-complex of acute hæmor-

rhagic pancreatitis. True, there is no pathognomonic sign in acute pancreatitis, but, with the vivid description in our mind, a probable diagnosis seemed justifiable and exploratory operation was certainly imperative.

Bearing in mind the pathology of acute hæmorrhagic pancreatitis, one should not hesitate in urging early surgical interference before necrosis and suppuration develop. I personally feel very strongly on this point, as I know from my own experience and observation that some of the cases lost after operation could undoubtedly have been saved by an early surgical intervention. As an illustration, let me cite the following histories.

CASE 2. Mrs. A. B., admitted to the Jewish Hospital, May 14, 1913. She was 48 years old, married 26 years, mother of five children. Previous menstrual history negative; menopause, four years ago. She was perfectly well until two weeks ago, when she was suddenly taken ill with excruciating abdominal pain, and, according to patient's description, had suffered more than during her severest labor pains. Pain was not relieved by morphine. This continued for two weeks until two days before admission, when she had another attack with vomiting, abdominal distention, and marked constipation.

On admission, the patient looked intensely ill. She suffered agonizing pain, was distended, had a dry coated tongue and foul breath. She looked extremely toxic. Her temperature was 102°, pulse 120, respiration rapid. Examination showed tenderness in the left hypochondrium. She was in no condition for immediate operation. Gastric lavage and repeated enemata gave some relief.

*Operation* the following day. Median incision. On opening the peritoneum there was an escape of a small quantity of fluid. The intestines were found enormously distended and paretic. There was no evidence of obstruction; pulsation in the mesenteric vessels was present and of good character, but the mesentery itself was the seat of slight induration, and the small intestines intensely cyanosed, almost black in color. Spots of fat-necrosis on the omentum.

Owing to the extreme distention of the intestines, enterotomy had to be performed. This was only slightly effectual in relieving the distention. A cæcostomy was then resorted to. The gastrohepatic omentum was then torn through, and the pancreas found enlarged, hard, and almost free in its bed. There was hæmorrhagic fluid in the retroperitoneum. A drainage tube and gauze were inserted to the tail of the pancreas. The gall-bladder was found distended and full of stones, but the desperate condition of the patient precluded further manipulation and the abdomen was rapidly closed. The patient was very restless and the distention still persisted. She than developed an anuria. Her urine, the following day, was found to contain 10 per cent sugar. The cæcostomy wound did not seem to give any relief to the sympathetic paresis of the bowel. The patient was restless, became stuporous, and there was distinct evidence of a profound intoxication. She later developed involuntary urination and defecation and finally died from exhaustion on the twenty-first day after operation.

CASE 3. I. R. C., age 57, admitted September 30, 1913. Twenty years ago patient had the first attack of pain in the right side of the abdomen, radiating to the back and shoulder, with vomiting. She had a number of similar attacks until about ten years ago, when they suddenly ceased and she has been well since, with the exception of persistent constipation and an occasional attack of what she termed "dyspepsia" for the last few years. The present attack occurred two days before admission and began with vomiting after an evening meal, developing later severe pain in the left side of the abdomen. On admission, temperature 100°, pulse 122, respiration 22. Patient looked very ill. Suffered from pain and abdominal distention and was very tender in the left side of the abdomen.

*Operation* the following day. High rectus incision, spots of fat-necrosis on omentum and mesentery, intestines deeply congested and cyanosed; pancreas acutely inflamed with areas of hæmorrhagic and gangrenous degeneration. Hæmorrhagic fluid in the lesser peritoneal cavity. Drainage inserted down to the pancreas and the abdomen closed. Patient did not react well; there was bleeding from the abdominal wound and she became very restless; there was a rise of temperature to 104.6°, pulse 160, marked prostration. Did not respond to stimulation. Vomited coffee-ground material, involuntary urination and defecation. She died the following day with symptoms of a marked intoxication.

In contrast to this, let me report the history of the next cases.

CASE 4. H. F., admitted to the Jewish Hospital, May 13, 1913. The patient was a male, 32 years of age; enjoyed good health until nine weeks ago, when he was taken ill with an attack of pain in the abdomen, for which he was treated in another hospital for a few days and was then sent home, no diagnosis having been made. Three days before admission, he was awakened from his sleep by severe abdominal cramps and vomiting. The pain continued for two days, accompanied by marked constipation. On admission, his temperature was 100.4°, pulse 108, respiration 40. His abdomen was enormously distended. There was marked tenderness in the left side of the abdomen. Urine showed a specific gravity of 1,030; acid; trace of albumin; and a trace of acetone. The patient obtained great relief from enemata, with the expulsion of flatus and good bowel movements. He was given nothing by mouth and was operated on the next day.

*Operation.* Right rectus incision. On opening the peritoneum a few drachms of free fluid escaped.

The intestines were distended and markedly cyanotic; no fat-necrosis was observed; the pancreas was palpated and found enlarged, firm, and indurated; the gastrohepatic omentum was opened and a quantity of bloody fluid was liberated; spots of fat-necrosis were found on the pancreas. Rubber-tube drainage and iodoform gauze were applied to the tail of the pancreas and the abdomen was closed. The patient ran a moderate febrile course for a few days and suffered from considerable distention. His condition gradually improved, however; drainage was removed on the eighth day, and patient made a very satisfactory recovery and was discharged on the eighteenth day after operation, cured.

CASE 5. Lizzie B., age 48, admitted October 30, 1912. Married, mother of four children, menopause twelve years ago. Diagnosis, acute hæmorrhagic pancreatitis. For the past three years has been complaining of epigastric pain, which was localized and bore no relations to meals. Recently, pain became more marked, occurred more frequently, and was accompanied by chills, fever, and vomiting. On admission, temperature 102°, pulse 124, respiration 28.

*Operation* the following day. Abdomen opened; gall-bladder normal; fat-necrosis on omentum, which was friable; pancreas exposed; lesser peritoneum contained a quantity of odorless serosanguineous fluid; an area of about 2 inches of necrosis in tail of pancreas. Tube gauze drainage down to pancreas. Recovery rapid and uneventful. Discharged on the twenty-fourth day after operation.

CASE 6. Ray L., age 49, admitted October 17, 1913. Married, mother of nine children, menopause six years ago. Diagnosis chronic cholecystitis and subacute pancreatitis. Has been suffering from "stomach trouble" for the last twenty-four years, consisting of pyrosis, eructations, and constipation. During the last six years, has had a number of attacks of pain in the right hypochondrium extending to right shoulder, with vomiting. Was operated on for gall-stones two years ago with complete relief of all symptoms until present attack three weeks ago, when she developed severe abdominal pain with marked prostration. Has since had frequent similar attacks with chills and fever. Examination showed a short, very obese woman with a distended abdomen, suffering from intense pain and tenderness in the right hypochondrium and epigastric regions. She was placed under observation in the hospital for some time and was operated on November 19, 1913. Abdomen opened; pancreas found hard, irregular, nodular and enlarged. A quantity of bloody fluid found in the lesser peritoneal cavity, with fat-necrosis. Recovery good. Discharged from the hospital on the thirtieth day after operation.

CASE 7. Pearl K., age 19, admitted December 9, 1913. Married two and one-half years, mother of one child. Menstrual history normal. Has had recurrent attacks of pain in the right hypochondrium radiating to right shoulder blade. Pain also in the epigastric region. Has had chills, vomiting, and jaundice, clay-colored stools and dark urine. Operation day after admission. Right rectus incision. Gall-bladder contained a number of stones. Spots of fat-necrosis on viscera of upper abdomen. Head of pancreas enlarged. Gall-bladder drained, rubber-tube-and-gauze drainage to pancreas. Discharged on the eighteenth day with good recovery.

*Operative diagnosis.* Since, as stated before, it is impossible in many cases to make a pre-operative diagnosis, it is important when opening the abdomen to bear in mind the characteristic lesions associated with this disease, which are as follows:

1. The presence of an odorless, serosanguineous, or "beef-juice" fluid in the peritoneal cavity.

2. The presence of fat-necrosis in the form of sulphur-yellow spots, which appear disseminated over the omentum, the mesentery, and the parietal peritoneum. This is an unmistakable and pathognomonic sign of acute hæmorrhagic pancreatitis.

However, in some cases coming to operation early, both of these findings may not be present on opening the abdomen. Then the pancreas should at once be palpated, and, if this appears swollen, it should be exposed, when the hæmorrhagic fluid around the pancreas together with fat-necrosis may be discovered, as it has been my experience in some of my cases.

One of the diseases that acute hæmorrhagic pancreatitis is frequently mistaken for, even when the abdomen is opened, is acute intestinal obstruction, high up, especially when the characteristic fluid and fat-necrosis is not discovered. This happened to me in three consecutive cases, in each a condition presenting itself at operation calling for a differential diagnosis between acute pancreatitis, acute intestinal obstruction, and mesenteric thrombosis, all cases in which I strongly suspected acute hæmorrhagic pancreatitis. Upon opening the abdomen in these cases, I found no fat-necrosis and no serosanguineous fluid, but the small intestines appeared so markedly cyanotic as to suggest either mesenteric thrombosis or a strangulation due to some mechanical obstruction. But, bearing in mind the clinical picture of these particular cases, and before eventrating all

the viscera and thus producing a great amount of injury to the organs and shock to the patient, I at once palpated the pancreas, found it swollen, exposed it, and obtained the characteristic serosanguineous fluid in the retroperitoneal space with fat-necrosis on the pancreas.

I should like to mention one other sign that I have observed, and that is the change in the consistency of the omentum. The omentum seems to have lost its peculiar fatty or oily feel and has assumed or gives a sensation of being granular or gritty to the touch. In operating on three cases for gall-stones, this peculiar condition of the omentum led me to suspect and expose the pancreas as complicating the other conditions, and the characteristic lesions were found.

In the severe diseases of the biliary tract, suppurative pancreatitis and localized abscesses are frequently overlooked; and the recurrent pain after gall-stone operations is often attributed to unremoved stones or to the formation of new stones. In this form of pancreatitis we very rarely, if ever, find the characteristic fat-necrosis which is always present in the acute hæmorrhagic pancreatitis.

*Complications.* Among other complications incident to any peritonitis, one especially peculiar to acute pancreatitis is post-operative hæmorrhage. The location of this gland, in a region so abundant in large blood-vessels and the corrosive action of the pancreatic ferments on these vessels may cause a severe and fatal hæmorrhage. Such hæmorrhages may occur immediately after operation or many weeks later. I lost one patient from repeated hæmorrhages, the last one of which proved fatal on the seventy-fourth day after operation. The history of this case is as follows:

CASE 8. S. S., female, age 25, admitted to the Jewish Hospital, May 1, 1913. Patient was married seven years, and the mother of two children. Menstrual history negative. One month ago she had an attack of severe epigastric pain with chills and fever. One week before admission she had another similar attack while asleep. Two days ago, patient was awakened from her sleep by an attack of most severe cramps in the epigastrium and right hypochondriac region; she vomited; constipation was marked. On admission, the patient suffered from marked prostration, great distention of the abdomen, and exquisite tenderness on the left side.

*Operation* on day of admission. High rectus incision. Large quantity of reddish fluid in the peritoneal cavity. Omentum studded with spots of fat-necrosis. On opening the gastrohepatic omentum a quantity of hæmorrhagic fluid was evacuated. Rubber-tube-and-gauze drainage inserted to the pancreas. The patient was returned to the ward in fair condition. Her convalescence was complicated by an attack of acute nephritis and later by an acute parotitis. She had frequent elevations of temperature. She finally began to show signs of improvement, but on the forty-eighth day after operation she complained to the nurse of feeling very ill. She became pale, her pulse was imperceptible, she was covered with cold, clammy sweat, and profuse bleeding from the wound was noticed. She recovered from the immediate shock, but the next day bleeding from the wound continued, and she vomited some blood. She made a slow recovery from this condition, and was ready to be discharged when, a few weeks later, she had a sudden severe hæmorrhage from the stomach, and passed considerable blood by the bowels. She died on the seventy-fourth day after operation.

*Prognosis.* The mortality of this disease is still high. In a series of 34 personal cases reported by Professor Körte two years ago, sixteen patients died, giving a mortality of about 47 per cent. In my own series of eight operative cases, four cases made a complete recovery and four died. Of the latter, one died on the seventy-fourth day after operation from a late post-operative hæmorrhage. In general, the prognosis will depend upon the severity of the disease, the general condition of the patient, and, particularly, the age. One of the most important elements in the prognosis is the early recognition of the disease and the prompt surgical intervention.

### METHODS OF APPROACH TO THE PANCREAS

The topographical position of the pancreas is responsible for many of the difficulties in the establishment of a positive diagnosis, but a still greater obstacle do we meet when attempting to attack this organ surgically. Nature, in her wisdom, has concealed this important and vital organ behind and under other organs in the upper cavity of the abdomen, thus placing it in a most secure position to protect it against injury; and this very fact makes it difficult for the surgeon to attack it and to drain it properly. Generally

speaking, there are two ways of exposing the pancreas: the transperitoneal and the retroperitoneal. In the former, the abdomen is opened and the pancreas is exposed either through the gastrohepatic omentum or by lifting up the transverse colon and omentum and then perforating the mesocolon. Körte has devised another method. He mobilizes the duodenum, after incising the peritoneum, and then inserting the finger, he can explore the head of the pancreas. The retroperitoneal method consists of an incision in the lumbar region; and, by going in below the lower pole of the kidney, one can explore the tail of the pancreas. This is suitable only in special cases, where there is involvement of the tail of the pancreas producing a left subphrenic abscess pointing in the lumbar region. But frequently, in addition, the abdomen must be opened to provide for proper drainage.

It is thus evident that operation on the pancreas is neither easy nor simple, and is attended with considerable danger, especially in the possibility of injuring the surrounding organs.

The rational surgical treatment of acute hæmorrhagic pancreatitis cannot be better illustrated than by quoting von Mickulicz. "We may consider acute pancreatitis as an acute phlegmon which, on account of the peculiar nature of the tissue, runs an unusually severe course. As in any ordinary phlegmon, so in the pancreas the only rational therapy is to open the focus of infection by multiple puncture and drain the toxic and infectious tissue. Wide gauze tamponade would best control hæmorrhage and will best localize and drain this organ."

In my own series of cases the pancreas was approached in all cases but one through the gastrohepatic omentum. Multiple puncture of the pancreas was practiced, with rubber-tube-and-gauze drainage through the opening in the lesser omentum. In one case I drained to the left of the ligament of Trietz through the omental bursa.

## CONCLUSIONS

A positive diagnosis of acute hæmorrhagic pancreatitis cannot be made with absolute certainty, since we still lack a distinct pathognomonic sign for this disease. Laboratory aids, such as the Cammidge reaction and the Wohlgemuth diastase blood-test are of no value in this condition.

A tentative or probable diagnosis can be made in a certain number of cases, provided a careful history is obtainable and the various phenomena, as they present themselves, are properly interpreted.

The most striking feature of this condition, clinically, is the evidence of peritoneal disturbance in the upper abdomen, the so-called "acute abdomen" which all surgeons agree is an indication for surgical interference; and acute hæmorrhagic pancreatitis should always be borne in mind in such cases.

When finding the peculiar odorless, serosanguineous fluid and the small flecks of fat-necrosis, it is direct and undoubted evidence of acute hæmorrhagic pancreatitis.

The best results are obtained in cases in which operation precedes the stage of necrosis or pus-formation. Hence, early surgical intervention in all such cases will be rewarded by more frequent recoveries.

The writer's personal observation of the intense cyanosis of the distended small intestines, with the peculiar granular or gritty feel of the thickened great omentum, has helped him in many cases to recognize the condition at operation, and look to the pancreas at once as the cause of the trouble. This is of special value in cases operated upon for supposed intestinal obstruction.

The abdomen opened, the condition should be looked for and recognized quickly. Then prompt and efficient drainage should be instituted, causing the patient as little shock as is compatible with good surgical technique.

The high median incision is the best one to use, because it is the most favorable for exploratory purposes. The lumbar incision has its indications, but is only rarely resorted to, and then usually in late cases when abscess is pointing in the lumbar region.

Post-operative hæmorrhage is not an infrequent cause of death. It is due to necrosis, usually occurring in late cases. Therefore, early operation and gentle manipulation is the prophylactic treatment for this unfortunate complication.

# TREATMENT OF ACUTE INFECTIONS

By FREDERICK G. DYAS, M.D., Chicago

THE amazing results achieved by heliotherapy in the treatment of tuberculosis both of the surgical and pulmonary type, and the scientific demonstration of the fact that certain rays of the sun penetrated the tissues, either inhibiting or destroying not only the tubercle bacilli but other pathogenic organisms associated with them, as reported by Leuba[1] from the clinic of Rollier, led me to undertake some experimental work in the hope that some satisfactory substitute for the rays of the sun might be obtained through some source always at our command. The experimental work was carried on simultaneously at St. Luke's and Cook County hospitals. In a review of the literature many conflicting reports were found as to the bactericidal action of the X-rays. Much of the work reported by writers on this subject was ten years or more ago. So it was decided to systematically expose the commoner varieties of pathogenic bacteria to the action of the X-rays for varying lengths of time, with different intensity of current and at varying distances from the tube, to determine the behavior of pathogenic bacteria when exposed to the röntgen rays. Kolle and Wassermann[2] give the results of certain experiments as follows:

1. Mink, Wirrlin, Blaise, and Sambuc found that exposure of cultures of pathogenic organisms to the X-ray for forty-eight hours at a distance of twenty millimeters was completely without effect.

2. Reider after twenty to thirty exposures saw inhibition and death of the cholera vibrios and colon bacillus.

3. Frantzius reports inhibition of the lyssa virus after one hour's exposure.

4. Clinically it was believed that any good effects were due to the irritating effect upon the tissues and not to any bactericidal action of the X-rays.

5. General infections in animals were found to be unfavorably influenced by exposing the animal to the röntgen rays.

6. Tuberculous foci are helped by X-ray exposure.

7. Leucocytosis is diminished (Moody).

The following technique was followed in our work:

1. Fresh twenty-four-hour cultures of hæmolytic streptococci were plated out on blood agar in Petri dishes. The bacteriologic work was done by Dr. Moody of St. Luke's Hospital and the X-ray work by Dr. Van Horn, to both of whom I wish to express my thanks and appreciation for their expert help.

2. The Petri dishes were then exposed as follows:

1. 18 inches..... 2 milliampere minutes
2. 18 inches..... 4 milliampere minutes
3. 18 inches..... 6 milliampere minutes
4. 18 inches..... 8 milliampere minutes
5. 18 inches.....10 milliampere minutes
6. 18 inches.....12 milliampere minutes
7. 18 inches.....14 milliampere minutes
8. 18 inches.....16 milliampere minutes
9. 18 inches.....18 milliampere minutes
10. 18 inches.....20 milliampere minutes

Immediately after exposure the Petri dishes were placed in the incubator. Twenty-four hours later the Petri dishes were examined and all were found to have luxuriant growths. There was no difference between the control and the exposed plates.

2. Another series of blood-agar plates inoculated with fresh cultures of hæmolytic streptococci was treated as follows:

A medium hard tube was used and the plates exposed at a distance of 24 inches.

1.....26 milliampere minutes
2.....30 milliampere minutes
3.....34 milliampere minutes
4.....38 milliampere minutes
5.....50 milliampere minutes

These plates immediately after exposure were placed in an incubator. Examination 24 hours later revealed a luxuriant growth on all the plates.

The growths on the control and exposed plates were identical.

Plate No. 5 was covered by a lead shield with a one-inch square hole cut in the center. This plate, although exposed 50 milliampere minutes, showed the best growth in the unprotected area corresponding to the square hole, after 24 hours' incubation.

Another series of staphylococcus aureus was exposed. In this group fresh twenty-four-hour cultures of the staphylococcus aureus were plated

[1] Deutsche Zeitschr. f. Chir., 1913, November.

[2] Handbuch der Pathogenen Mikroorganismen, iii, p. 459.

| Organisms | Exposures, Milli-ampere Minutes | Control Culture | Exposed Culture |
|---|---|---|---|
| Staphylococcus pyogenes albus | 2 | Growth | Growth |
| Pneumococcus | 2 | No growth | Growth |
| Hæmolytic streptococcus | 2 | Growth | Growth |
| Streptococcus mucosus | 2 | Growth | Growth |
| Staphylococcus pyogenes albus | 5 | Growth | Growth |
| Pneumococcus | 5 | Growth | Growth |
| Streptococcus | 5 | Growth | Growth |
| Streptococcus | 5 | Growth | Growth |
| Streptococcus mucosus | 5 | Growth | Growth |
| Staphylococcus pyogenes albus | 10 | Growth | Exposed growth |
| Pneumococcus | 10 | Growth | Growth |
| Hæmolytic streptococcus | 10 | Growth | Growth |
| Streptococcus mucosus | 10 | Growth | Growth |
| Staphylococcus pyogenes albus | 15 | Growth | Growth |
| Pneumococcus | 15 | No growth | No growth |
| Hæmolytic streptococcus | 15 | Growth | Growth |
| Streptococcus mucosus | 15 | Growth | Growth |
| Staphylococcus pyogenes albus | 20 | Growth | Growth |
| Pneumococcus | 20 | No growth | No growth |
| Hæmolytic streptococcus | 20 | Growth | Growth |
| Streptococcus mucosus | 20 | Growth | Growth |
| Staphylococcus pyogenes albus | 30 | Growth | Growth |
| Pneumococcus | 30 | No growth | No growth |
| Hæmolytic streptococcus | 30 | Growth | Growth |
| Streptococcus mucosus | 30 | Growth | Growth |
| Staphylococcus pyogenes albus | 40 | Growth | Growth |
| Pneumococcus | 40 | No growth | No growth |
| Hæmolytic streptococcus | 40 | Growth | Slight growth |
| Streptococcus mucosus | 40 | Growth | Mod. growth |
| Staphylococcus pyogenes albus | 50 | Growth | Growth |
| Pneumococcus | 50 | No growth | No growth |
| Hæmolytic streptococcus | 50 | Growth | Slight growth |
| Streptococcus mucosus | 50 | Growth | Growth |
| Staphylococcus pyogenes albus | 60 | Growth | Growth |
| Hæmolytic streptococcus | 60 | Growth | No growth |
| Streptococcus mucosus | 60 | Growth | Slight growth |
| Pneumococcus | 60 | No growth | Growth of contamination Staph. Pyog. albus. |

out on blood-agar and the following exposures made to the X-rays.

A medium hard tube was used and the plates exposed at a distance of 12 inches from the tube.

1. . . . . 15 milliampere minutes
2. . . . . 20 milliampere minutes
3. . . . . 25 milliampere minutes
4. . . . . 30 milliampere minutes

After 24 hours' incubation all these plates showed a luxuriant growth corresponding to the control. There was no difference in the appearance in the exposed and control plates.

For the work done at Cook County Hospital, I desire to thank Dr. James Wilson of the House Staff, who spent a great deal of time and labor in obtaining cultures and plating them out and carrying out the bacteriological side of the work, and to Dr. Blayne for his kind assistance in the X-ray exposures.

In all these cases a tube of approximately five inches air resistance was used, 220 volts, no filter in any case.

The tube in each instance was placed at a distance of 18 inches from the plate.

Cultures were all grown on blood-agar plates with controls. The accompanying table gives the results of this work.

It will be readily appreciated from the results obtained in the experiments described that animal tissues could not withstand the reaction from exposure to X-rays sufficiently strong to have any effect upon the organisms used, and we believe it safe to say that from a clinical standpoint X-rays are useless in the treatment of infections except in the case of the tubercle bacillus.

In spite of our failure to demonstrate any bactericidal action of the X-rays it still seems reasonable to suppose that in certain cases some such action does exist as evidenced by the temporary subsidence of the glandular swellings in Hodgkin's disease, which has only recently come within the classification of infectious diseases, after treatment with X-rays. Furthermore, many of us have seen the disappearance of epitheliomata under X-ray treatment and we must believe that cancers are infectious.

There is little doubt in my mind that every lesion which develops by lymphatic invasion and glandular enlargement will finally be brought into the category of infectious

diseases. The leucæmias, carcinoma, and sarcoma all bear the marks of infections.

Many pathogenic microörganisms are killed by exposure to the rays of the sun and it seems reasonable to suppose that when it becomes possible for us to produce some form of rays which will be comparable to the rays of the sun, so far as its bactericidal action is concerned, then, I believe, we shall have taken a long step forward in the treatment of infections.

CONCLUSIONS

1. The X-ray which could be withstood by living tissues has no influence upon pathogenic bacteria.

2. Successful results following its use clinically are probably due to the increased hyperæmia and local tissue irritation.

3. The failure of the X-ray does not prove that some other form of rays or light or radio-active substance might not be successful in the treatment of infections.

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# WEAK FEET

By W. BARNETT OWEN, M.D., F.A.C.S., Louisville, Kentucky

An adequate appreciation of the symptomatology, pathology, and treatment of foot deformities, especially the so-called weak-foot, is difficult without at least a superficial understanding of the anatomy and physiology, the normal relationship of the osseous, ligamental, and muscular structures composing the foot and ankle, and the mechanism involved in production of such deformities. It must be remembered that while the ankle-joint is distinctly ginglymoid, it is not strictly diarthrodial as is the shoulder and hip.

The osseous segments constituting the so-called outer and inner foot arches are: The inner arch, composed of (a) the calcaneum, (b) the astragalus, (c) the scaphoid, and (d) the three cuneiform bones. The outer arch, embracing (a) the outer portion of the calcaneum, and (b) the cuboid bone. As in other anatomical situations, the soft structures are (a) ligamental, (b) fascial, and (c) muscular. Among the most important in relation to special deformities are the plantar ligaments and fascia, the tendo Achillis, and the plantar, peronæus longus, and gastrocnemius muscles.

It has been tritely remarked that the plantar "bowstring" (fascia, muscle, ligament) "is the weakest and at the same time the strongest portion of the foot." Notwithstanding the tremendous force which, through accident or otherwise, these structures are sometimes compelled to withstand, unlike the apparently stronger tendo Achillis, rupture almost never occurs. If exposed to prolonged strain, however, elongation, stretching, and weakness may ensue. On the other hand, as a logical result of non-use, the plantar tissues may become atrophied and shortened, and muscular power is correspondingly minimized.

Careful study and comparison of ancient and modern orthopedic literature induces the inevitable conclusions that weak-foot has markedly increased during the last few years, and that it appears to be largely a product of ultracivilization from disturbance of function of the foot and leg muscles entailed by the prevailing fashions in footwear. This statement seems reasonable when it is remembered that the ratio of increase in frequency of the deformity is greater in females than in males.

While it may be true no definite standard can be established as to what constitutes a normally shaped foot, the fact remains that flattening of the plantar arch is usually an evidence of weakness or other abnormality of certain muscles. The observation is interesting in this connection, however: that it has been demonstrated by investigation that in certain races (Indian, Negro, Japanese) the normal foot appears flat when compared with the high plantar arch of the more civi-

lized races, yet muscular development, strength, and functional activity are considerably greater in the former than in the latter. This would indicate that with normal musculature a moderately flat foot need not necessarily be weak, but a more reasonable explanation is that in the red, black, and yellow races the valgus position and the wearing of shoes are not obligatory, and when worn they are usually more of the moccasin type; thus muscular development is not impeded by abnormal balance of the body weight as occurs in the fashionable and so-called ultracivilized. The pernicious habit of wearing high-heeled shoes has extended to those of tender years, in certain quarters, and as a result weak-foot has markedly increased among school children. The mechanically disturbed functional relationship between the various foot and leg muscles is believed to be the most important etiological factor in the production of so-called weak-foot.

Weakness and pain are the most prominent symptoms, especially when standing or walking for a considerable length of time. Pain is usually noted first in the ankle (or heel) and may radiate toward the calf, thigh, and back. There is marked limitation of normal motion (especially adduction), with a feeling of stiffness in the ankle-joint. Muscular spasm may or may not be present. The foot swells after prolonged standing or walking, and distention of the superficial veins is commonly observed.

While the diagnosis is not difficult in typical cases, the fact must be constantly borne in mind that there may be normally a low inner arch with more or less discomfort upon standing or walking, yet without muscular weakness, abduction, or marked limitation of normal motion. This type of practically normal foot has been particularly noted in certain races, as already stated. In such instances there may be some confusion in the diagnosis. When lowering of the inner arch is not pathological, relief from discomfort may usually be obtained by rest without mechanical or other treatment.

The essential pathology in typical weak-foot is an abnormal relaxation or stretching of the plantar tissues, thus permitting descent of the inner arch. The ligamental and muscular structures which should normally maintain the astragalus, scaphoid, and cuneiform bones in correct apposition, in lesser degree also participate in the pathological process and contribute toward the production of deformity. The tendo Achillis is abnormally shortened from habitual elevation of the heel, and the gastrocnemius becomes atrophied from non-use. In long-standing cases, owing to the changed conditions, the foot may become fixed in exaggerated abduction resulting in the so-called rigid foot described by previous authors. The unused portions of the articular surfaces may become denuded of cartilage, and new facets may be formed to accommodate the changed osseous relations. The periosteum at certain points may show evidence of injury from the effects of increased pressure.

Nearly every orthopedist adopts a different method of treatment. For instance, some use braces only, some use exercise only, while others use both braces and exercise. I believe the special type of deformity is suggestive of the proper treatment. For example, an aggravated, painful, rigidly abducted foot, regardless of the age of the patient, should be thoroughly stretched by force under anæsthesia into a position of adduction, at least to right angles and if possible into slight dorsoflexion, and held with plaster dressing for at least two weeks, after which an impression is taken, with the foot held in a normal attitude, from which a brace is made after the method described by Whitman. (In this class of cases a brace is required; do not consider a plate as a brace.) It is necessary to hold the foot in the corrected position for at least one year. We should never regard a brace as a corrective agent in these deformities: it is only expected to hold the foot in the corrected position, and prevent recurrence of the deformity.

The attitude, or the proper body balance, is the first point to be accomplished; then of equal imperative importance is the development of the muscles in their proper supportive channels by massage and active motion properly directed. In the majority of in-

stances, however, this will not prove satisfactory unless the patient has been thoroughly drilled as to the exact kind of exercise to be taken. Advice alone is not sufficient; you must have a class in charge of a competent director. It is necessary to have regular and systematic active motion in every case of weak-foot, regardless of the degree or type. It is impossible to obtain the desired result so long as the patient wears improper and ill-fitting shoes. The shoes should be built to allow the foot to acquire the normal attitude. Many beginning cases of weak-foot can be permanently relieved by modification of the shoes to cause an internal elevation of the heel, throwing the body weight to the outer border of the foot.

While my remarks are directed to the correction of pathological conditions, it is always more important to prevent the occurrence of foot weakness. This could be done in nearly every instance if the patient were taught the necessity of properly balancing the body weight upon the feet, and would not wear shoes that interfered with normal muscular function and bony relationship. We are getting too far from nature. Shoes should be worn that suit the feet and not the eye. With the exception of weak-foot resulting from trauma, infectious arthritis, and paralysis (which will not exceed 5 per cent), this deformity is unnecessary and preventable.

In practically all cases where a weak foot is not rigid, a cure can be effected by strapping the foot every five days in the attitude of adduction, at right angles, the application of proper shoes, and active exercise. The time required for a cure varies according to the degree of advancement and the coöperation of the patient.

Weakness of the anterior metatarsal arch, which was first recognized and described by Morton of Philadelphia and familiarly known as the "Morton toe," results from weakness or depression of the anterior metatarsal arch as a whole or in part. He claimed the affection was a neuralgia caused by compression of the plantar nerves. Anterior metatarsalgia has been suggested by various authors as a more distinctive term. In practically every case this type of deformity is produced by improper shoes. It occurs more frequently in women, as their shoes have narrow soles and high heels which throw the foot in position to cause contracture of the common extensors. This condition may become so exaggerated that it may be necessary to transplant the common extensor tendons into the neck of the metatarsal bones, or to remove completely the point of greatest pressure, which is found beneath the head of the metatarsal bone. Gibney recommends the institution of a high arch and low heel, in order to remove part of the pressure from the heads of the metatarsal bones. Forcible plantar flexion and adduction under anæsthesia, the foot being held in this position about two weeks, has proved beneficial in some cases. I do not believe there is any condition of the foot that will produce more trouble and pain, and prove more difficult to relieve permanently, than anterior metatarsalgia.

## CONCLUSIONS

1. Weak-foot occurs more frequently in females than in males, and in the majority of instances is caused by the wearing of improper shoes.

2. The most reliable diagnostic symptom is pain when standing or walking, which is relieved by rest.

3. As a prophylactic measure, normal individuals should be taught to walk with the feet parallel.

4. Abducted feet should be forced to acquire a normal attitude by a fulcrum at the calcaneo-astragaloid joint.

5. All weak feet are amenable to treatment by mechanical or operative measures and proper exercise, with application of appropriate shoes.

6. All mechanical support should be withdrawn as soon as muscular power has been sufficiently developed.

# THE SILENCE OF RENAL TUBERCULOSIS[1]

By G. S. GORDON, M.D., C.M., F.A.C.S., Vancouver, B. C.
Urologist, Vancouver General Hospital

WE are taught that pain is one of the most constant of the five cardinal symptoms of inflammation, consequently pain in the kidney is one of the first things inquired for when tuberculosis of that organ is suspected. If there is no pain and never has been, we seek to elicit it by pressure. If there is no pain on pressure we conclude there is no renal inflammation. Yet this conclusion is often unwarranted; there are cases of renal tuberculosis which run their whole course without localizing pain or even an ache in the small of the back. These we term "silent," as they utter no word implicating the kidney and leave us to spell out the condition in other ways.

If we consider the causes of renal pain intrinsic to tuberculosis of the kidney, we can better understand why some of these patients have acute renal colic, an intermittent pain or ache in the loin, or a constant pain or ache; while others, as in the four cases reported tonight, never have pain in the renal region at any time.

*Innervation.* Innervation of the renal parenchyma is from the sympathetic system traceable from the renal plexus along the vessels of the kidney, through the hilum, and is lost in the cortex itself. A branch supplies the ureter, and another branch supplies the ovary or testis. The nerves of the capsule do not seem to have been demonstrated. The adjacent somatic nerves which may be affected by pressure on them from ballooning of the kidney or ureter or by spread of the inflammation to them, are the last dorsal, the iliohypogastric, ilio-inguinal, genitocrural, and the external cutaneous.

The kidney itself is almost, if not quite, insensitive to *contact* or *pressure*. In Bright's disease the parenchyma may be congested in places and fibrous in others, without pain. Pain is not an essential accompaniment of inflammation of the parenchyma. On the other hand, *distention* of the kidney from within is agonizing in effect. The classic picture of renal colic is produced by suddenly damming back a continuous flow of urine by a stone in the ureter. This pain may come from squeezing the parenchyma against the capsule, whence it might radiate down the ureter or to the testis; but also it may come from stretching the capsule itself, or from pressure of the distended kidney or ureter on adjacent nerve-trunks, whence it might radiate to the dartos, cremasteric, etc. Sudden violent distention of the ureter or capsule is necessary to produce colic. Tying the ureter apparently gradually inhibits the excretion of urine and as there is no violent distention, no colic follows this procedure. The obstacle which produces colic must allow of slight leakage, of intermittency of flow, or of movement onward, sufficient to encourage the kidney to keep on functioning, or sudden, violent distention and consequent pain does not occur. The spasmodic character of this pain is probably due to change in pressure with peristalsis. When excretion of urine stops, pain eases up; when the urine is absorbed, pain from this cause ceases.

The obstruction in early tuberculosis of the kidney is usually a blood-clot from an eroded vessel; later on in the disease it may be a blood-clot, caseous material, gravel (if a gravel-forming infection is superadded), stricture of the ureter, or sudden occlusion of the ureter by kinking. The suddenness of distention and its extent determine the degree of pain. It may be all the way from typical colic down to an intermittent dull ache. If distention is very gradual there may be only a weak back or no pain at all as in Case D. 12. 3. 14, while in cases with no obstruction to the free flow of urine, pain in the kidney is not to be expected at all unless from the spread of the disease to adjacent structures, and this is very rare when there is no distention. Finally, when we consider that the renal tubules, calyces, pelvis, and ureter not only form an escape for inflammatory products, but also constitute a flushing system in which the

[1] Read before the Vancouver Medical Association, October 26, 1914.

urine acts not only as a diluent of blood, pus, and caseous material but also washes them out through comparatively large conduits, it seems remarkable not that pain in the kidney is often absent but that it is present in the majority of cases.

If, then, renal tuberculosis sometimes gives no localizing symptoms, what is to lead one to suspect its presence and how is diagnosis to be made in "silent" cases?

Tuberculosis of the kidney should be thought of—

1. When a patient presents himself for loss of weight and strength when no other cause can be found, if there are pus-cells in the urine.

2. When he presents himself for hæmaturia; and, finally,

3. When he consults us for cystitis: for although tuberculosis of the kidney may give no symptoms, tuberculosis of the bladder, secondary to renal tuberculosis, practically always speaks out and in advanced cases speaks out very loudly.

*Diagnosis.* There are always pus-cells in the urine. If the case is one of hæmaturia, the leucocytes may be masked by the large numbers of red cells; but after the bleeding has stopped the pus-cells will be found. The only possibility of the pus-cells being absent occurs when the tubules or ureter through which they come is blocked. One must be on guard if the urine is alkaline; then the pus-cells may lake on standing, and for this reason all urine should be inspected microscopically as soon as possible after it is voided. It is my custom always to have the specimen passed in the office, not brought in a bottle.

Pus being present in the voided urine, it can be demonstrated that it comes from a source above the urethra by the "two-glass test" or by catheterization. Pus in the second glass or in the last of the flow through a catheter is presumptive evidence of a seat of inflammation in the upper urinary tract.

This inflammation may be caused by one or many of the pathologic micro-organisms. For the most part they get along very well together. The gonococci and staphylococci are perhaps most frequently associated, the colon bacillus and the proteus bacillus more frequently are solitary invaders, but any of them may be found with the tubercle bacillus. Generally the tubercle bacillus is alone at first and cultures will therefore be sterile. Beware a pyuria sterile to culture! And, on the other hand, do not consider a cystitis non-tubercular because other microörganisms are present.

After pus has been found, stain for tubercle bacillus. If they cannot be found it does not follow that they are not at the root of the condition. Some claim that they can be demonstrated in 60 per cent or 90 per cent of cases. This percentage is altogether too high an attainment for most of us to achieve.

If tubercle bacillus cannot be found in the urine lose no time with the von Pirquet or Moro tests. If the temperature is normal inject ½ mg. of old tuberculin hypodermically and increase the dose if no reaction follows. If no reaction follows 2 mg. we may take it for granted there is no tuberculosis. Culture the urine. If it is sterile or if old tuberculin gives a reaction seek anew for tubercle bacillus in the urine and if again unsuccessful use the guinea-pig test. If this is negative, even if the old tuberculin test is positive, we have excluded tuberculosis of the urinary tract as nearly as possible. The only chance of error is that the focus is sealed so that no bacilli get into the urine. There are two other simple tests which may be tried for what they are worth. In tuberculosis the bladder is said to be extremely intolerant of silver nitrate irrigations, and when this salt is very badly borne it is suggestive. The second test is made by pressure on the ureter through the vagina or rectum. If renal tuberculosis is present a referred pain is felt in the kidney region. If tuberculosis of the urinary tract is present, its main focus and extent in "silent" cases must be made out by means of the cystoscope or by exploratory operations over both kidneys. This latter course is inexcusable when ureteral catheters can be passed, but advisable when they cannot. If this routine is followed fewer cases of renal tuberculosis will reach the surgeon at a stage when interference is hopeless.

In my small list of cases there are several which have had periods of rest from renal pain for years at a time; but that four on the list

were always "silent" shows how large a percentage of tubercular cases may be overlooked unless special attention be paid to all cases which may possibly have renal tuberculosis. Of these four cases three ended fatally. One of these three is recalled with self-condemnation, another was associated with errors on the part of my confrères, and the last died three days after she was first seen. The fourth case was diagnosed early and the prognosis, following operation, is very good, indeed.

CASE G. 12. 1. 12. This patient was a ground man of the British Columbia Electric Railway Company. For one year he had risen at night to urinate. When first seen he had passed urine every hour or two, night and day. There was urgency, and pain in the glans penis on holding his urine. There was pus in the urine and tubercle bacilli in large numbers from both kidneys, but the condition was much worse in the right kidney and from this side there was only a trace of urea. There was no pain over either kidney, and subsequently the bladder and prostate were opened and after that abscesses in the perineum were drained by surgical confrères who presumably were unaware of the ureteral findings. The case terminated fatally in six months.

CASE D.[1] 12. 3. 14. An Italian laborer was sent to consult me in March, 1912. He had a very contracted and chronically inflamed bladder with extension of infection to the posterior urethra, prostate vesicles, and left epididymis. He attributed the beginning of his illness to an attack of gonorrhœa contracted three years before and, when no tubercle bacilli but only staphylococcus aureus was found in the urine, the condition certainly looked like a venereal legacy. Ureteral catheterization was found impossible; but there had never been any pain over either kidney, and so nearly comfortable on pressure were both kidneys that the note "slight tenderness over right kidney" was followed by a question mark. Von Pirquet's test was negative. In the course of the next few months the bladder was drained suprapubically, the left testicle was removed, abscesses in the perineum and in the left seminal vesicle were drained. Post-mortem showed the left kidney to be nothing but a huge tubercular sac plastered high up on the diaphragm. The right kidney, which had been questionably tender, was congested only.

CASE F. 13. 3. 14. Mrs. F., 34 years, mother of four sturdy children. Except for malaria ten years ago and for symptomless hæmaturia seven years ago she was always well and strong. Her three months' illness dates back to when she first began to have frequency of urination and pain before and for a few minutes after voiding urine. No renal pain. The vesical symptoms increased in severity. When first seen she had the appearance of being severely septic. On examination her bladder capacity was 120 ccm. There was diffuse cystitis. The left ureteral orifice was set in a honeycombed hæmorrhagic area. The right ureteral orifice was more normal in appearance. The urine from both ureters was heavy with pus and contained many tubercle bacilli. The urea content was about the same from each side and was much below normal. She died three days after I first saw her.

CASE L. 14. 7. 6. A Norwegian laborer, 27 years old, was referred to me after three weeks' treatment for cystitis coli, the symptoms of which were discomfort in the perineum, frequency of urination night and day, with urgency even to incontinence on holding urine and an occasional trace of blood at the meatus after urination. There were no symptoms of any derangement of the sexual organs. The urine contained pus-cells throughout, but culture was negative. No tubercle bacilli could be found on repeated examination and the family and personal histories were against tubercular infection. He had never had any venereal disease. On cystoscopy the bladder-wall was found generally congested, most markedly about the left ureteral orifice. There were no typical tubercular ulcerations. The pus-cells in the urine came through from the left ureter only.

During this illness he had no elevation of temperature and no discomfort whatever over the kidneys, and there was no tenderness even on palpation. One-half milligram old tuberculin was injected and the temperature rose over one degree and there was local reaction as well. This was repeated with a like result. After renewed attention to the urine, tubercle bacilli were found. A sclerosed left kidney containing pockets of pus and the ureter were removed. There is still a sinus leading to the kidney pocket and two ecchymotic spots to be seen in the bladder; but he is holding his urine for increasingly longer periods without discomfort and he is gaining in weight and strength.

In conclusion let me sum up and make additions to the main point of this paper as follows:

1. Renal tuberculosis gives no local symptoms in a large percentage of cases.

2. Its first manifestation may be hæmaturia or symptoms of its spread to the bladder.

3. A history of gonorrhœa or the finding of colon bacillus, staphylococci, or other pathological microörganisms in the urine in no way excludes the concurrent presence of tubercle bacilli. In fact, renal tuberculosis predisposes the urinary tract to other infections and the tubercle bacillus is usually reinforced by such allies before it has progressed far in its invasion.

[1] Reported in full in the July, 1913, number of the American Journal of Urology.

4. The importance of early diagnosis of tuberculosis is fully recognized when the lungs are involved. It should be as fully recognized when its main focus is in the kidney; for it is usually unilateral at first, when the whole focus can be removed and the patient cured, but in time may become bilateral or miliary, when the case is hopeless.

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# DERMOIDS OF THE KIDNEY

By J. F. BALDWIN, M.D., F.A.C.S., Columbus, Ohio
Professor of Clinical Surgery, Medical Department, Ohio State University; Surgeon to Grant Hospital

Works on diseases of the kidney quite uniformly state that only two cases of dermoid of the kidney are on record, and with unanimity they refer to the celebrated case of Sir James Paget [1] and to the case reported by Professor Haeckel [2] in 1902. Investigation, however, shows that a few other cases are to be found in the literature. Paget's case was one of dermoid tumor of the kidney in the sheep. It seems strange that this error went so long without being discovered, but it was finally pointed out in 1913, by W. R. Williams.[3] The discovery was easily made, as the specimen in the museum of the Royal College of Surgeons is described[4] as follows:

"3558–A. A large tough-walled cyst, probably dermoid, which was found in the place of one of the kidneys of a sheep, and contained a mass of wool rolled up with fluid oil and fatty matter. The cyst is inverted; its walls are from one to two lines in thickness; its inner surface is rough and covered with portions of fatty substance, and part of the wool is fixed in it. A long, cylindrical tubular process is continued from the main cyst, and is similarly filled. The cyst was found in the middle of the mass of fat in which it was expected that the kidney lay. No trace of kidney appeared. The sheep was healthy and very fat, and had a good fleece. The kidney on the other side was very large."

Case 1. Haeckel's case, referred to above, was reported in full by his assistant, Wedemann, in his inaugural dissertation.[5] Female, aged 58. Had noticed some sort of swelling in the right side for several years, but only for a few months had it made itself prominent, with increased pain. A distinct tumor. No urinary trouble. Menopause at 37. A hard tumor about the size of a child's head in the ileocæcal region, smooth and globular; very movable, but it appeared to be fixed near the anterior superior spine. No involvement of lumbar region. No connection with the liver or genital organs. Operation, November 25th, 1901. Incision at the outer border of the right rectus. Tumor easily removed, with prompt recovery of the patient. The tumor was cystic, its surface nodular in places, filled with a pultaceous yellow substance, traversed with bundles of hair.

Case 2. (Reported by W. S. Goldsmith.[6]) The patient was a male, aged 20. Had had evidence of trouble with one kidney since two years of age. Frequent attacks of "colic." The tumor had been recognized for two years. Hæmaturia and great pain were pronounced features. The diagnosis was that of floating kidney with twisted pedicle. Kidney removed through a lumbar incision. Prompt recovery. Examination of the tumor showed kidney remains to be present, but the main mass was made up of a cyst containing a large quantity of reddish, mealy material matted together by hair.

Case 3. (Reported by E. W. Walker.[7]) Girl, aged 11 years. Had been subject to attacks of so-called "colic" for several years. The attacks would last several days, and were attended by nausea, vomiting, constipation, tympanites, and irritable bladder. Pain located in the left lumbar region, and tumor noticed for about one year in this region. No positive diagnosis made. Exploratory laparotomy, July 15, 1895. Median incision four inches in length. The tumor was found to be the size of a large orange. Had a long, slender, twisted pedicle, and had contracted light intestinal adhesions. Removal very simple. Prompt recovery. Examination of the tumor showed that it was 4½ inches long, 2½ inches wide, and 1¾ inches thick. Two-thirds of this was taken up by a cyst. There seemed to be three dermoid cysts, one of which was filled with fatty material and fine hair.

Case 4. (Reported by Schlegtendal, B., and Madelung.[8]) Male, aged 22. Had had a swelling in the right side of the abdomen as long as he could

[1] Surgical Pathology, London, 1853.
[2] Berl. klin. Wchnschr., 1902, xxxix, 964.
[3] Lancet, Lond., i, 561.
[4] Descriptive Catalogue Pathological Specimens in the Museum of the Royal College of Surgeons of England, London, 1885, iv, 18.
[5] Jena, 1902.
[6] Tr., Southern Surg. & Gynec. Ass., 1908, xxi, 95.
[7] Tr. Am. Surg. Ass., 1897, xv, 591.
[8] Arch. f. klin. Chir., 1887, xxxvi. 304.

remember, but this gave no trouble until six months before. The tumor was in the right upper abdomen, was quite extensive, and apparently connected with the liver. Diagnosis: Echinococcus of liver. At the operation two incisions were made, and the cyst opened and attached to the skin for drainage. About a bucketful of clear yellow fluid was withdrawn, but this contained neither hydatid vesicles nor hooklets. Patient improved for a few weeks, but then got worse, and died some months later. At the autopsy the liver occupied the greater extent of the abdomen. Marked amyloid degeneration. Spleen much enlarged and adherent. In the place of the right kidney was a long tumor, a portion of which extended to the abdominal wall, where a fistula persisted. The greater part of the tumor was of stony hardness, so that it had to be cut with a saw. Cystic spaces were present, filled with a whitish, smeary mass consisting of fine fat-cells, crystals of cholesterin, and epidermis. Renal parenchyma could be made out at various parts, and epidermal tissue was scattered throughout the calcified strata.

CASE 5. (Reported by Enrico Boni.[1]) Female, aged 45. Had had symptoms dating back about 15 years. Swelling noticed for ten years in the right side of the abdomen. Globular tumor present, extending from costal arch along the median line to the crest of the ilium. Not moved by inspiration. Indistinctly lobular. Not connected with the liver. Diagnosis: Hydronephrosis probably due to calculus. Operation, May 16, 1904. Incision at border of right rectus. Tumor removed as usual, with a large gauze drain left in the wound. Patient died four days later. The tumor, the size of an adult head, contained five intercommunicating cysts, filled with yellowish green turbid fluid, and detritus. The tumor showed typical structure of skin, with sebaceous sweat glands, hair follicles, and hair scattered throughout the several sections.

(A. G. Rider[2] published a report of a case of alleged dermoid cyst of the kidney with malignant degeneration. In the report of the autopsy, however, it is impossible to find anything pointing to a dermoid, and the tissue sent to the Clinical Research Society was reported as a columnar-celled carcinoma. The tumor was removed by operation, but the wound gave way with prolapse of the bowel, and death of the patient.)

AUTHOR'S CASE. Miss M. H., Degraff, Ohio. Physician, Dr. J. H. Wolfe. April 30, 1912. Age 16. Patient was seen rather hurriedly at the office of her physician. Appetite fair, bowels regular, kidneys normal, menstruation regular and normal. The mother stated that her daughter had had an abdominal tumor ever since she was a year or two old. When first discovered it was about the size of a hen's egg. Had grown with the growth of the child, but of late had been growing more rapidly. The patient was a hearty looking schoolgirl. She presented a tumor about the size of a cocoanut in the right side of the abdomen. This could be pushed freely in all directions. Because of her youth made no vaginal examination, but from the mobility of the tumor, and the history of its long existence, made a presumptive diagnosis of an ovarian dermoid, though the tumor was rather large for a growth of that character. Its prompt removal was advised.

I saw her next June 7, 1914, and examined her without removing her clothing. The tumor was about as before except somewhat larger, but still quite movable. Urged operation.

Operation, August 4, 1914, Grant Hospital, Dr. Wolfe being present. Examination under the anæsthetic showed that the tumor was not of pelvic origin. Its range of motion seemed to indicate that it was of the kidney and not of the ovary. It was hard in general, but irregularly so, feeling somewhat like a hydrocephalic head. Made an incision directly over the tumor, which was found to be retroperitoneal and to involve the kidney. A transperitoneal nephrectomy was made without difficulty. Pelvic organs normal. Appendix removed. To provide for any possible oozing from the large surface which was exposed, a cigarette drain was passed through a stab incision to be removed in a few hours. The colon was then carefully replaced, and the incision closed without other drainage. Patient made an ideal recovery.

Examination of the tumor before its removal showed that it involved the lower half of the kidney. The other half projected from the tumor and was apparently normal. Studied the specimen for a few moments to see if this much of the kidney could be saved, but finally decided against it, and the whole organ was removed and turned over to the pathologist. His report showed that it was a dermoid of the kidney involving the lower half. The walls of the tumor consisted largely of bony plates, while the interior had many cavities containing different colored fluids filled with cholesterin crystals. No hair.

[1] Osp. magg., Milano, 1906, i, 386.
[2] Lancet, Lond., 1906, ii, 1580.

# DEPARTMENT OF TECHNIQUE

## A SERIES OF ABDOMINAL CÆSAREAN SECTIONS PERFORMED UNDER LOCAL ANÆSTHESIA[1]

By J. CLARENCE WEBSTER, M.D., Chicago

ABOUT ten years ago I began using local anæsthesia in vaginal cæsarean section, and at that time and in the years following I have had quite an interesting series of nephritic and eclamptic cases at the Presbyterian Hospital in which the operation was carried out with Schleich's solution No. 2. There has very rarely been any difficulty in operating on these patients, and they have been saved from the risk which would have accompanied the administration of a general anæsthetic. My first abdominal cæsarean section under local anæsthesia was performed in December, 1909, on a very stout woman at term, whose pelvis was considerably blocked by a fibroid tumor about three inches in diameter. She was œdematous from head to foot and her urine was loaded with albumin and casts. Her condition was not favorable to the employment of a general anæsthetic, and abdominal cæsarean section entirely under local anæsthesia was performed, with a very gratifying result, saving both the mother and baby. The mother has had good health ever since the operation, although there has always been a slight trace of albuminuria.

Since 1909 I have operated in a similar manner thirteen times under local anæsthesia where there existed conditions, chiefly nephritic and pulmonary, which were not favorable to the use of a general anæsthetic. I have saved the mother in every case. Only one baby died, its death having nothing whatever to do with the operation, but being due to a defective heart. In one week in the spring of the present year it happened that I performed a series of five operations under local anæsthesia.

I do not know of any abdominal operation that is more satisfactorily accomplished and accompanied with less disturbance to the patient. I believe it is always indicated where conditions exist which would not admit of the administration of ether or chloroform. In the last two years I have used only novocaine, 1:200. Infiltration of the abdominal wall alone was necessary to the successful conduct of the operation.

A considerable number of years ago I made an extensive study of the sensitiveness of the different parts of the peritoneal cavity in patients operated without the use of a general anæsthetic. The observations were in agreement with those of Lennander of Upsala, who had independently made similar experiments. It was found that there was a marked difference between the parietal peritoneum and that covering the viscera, the former being markedly sensitive to pain, the latter being mostly insensitive, so that one could cut, burn, or stitch the intestines without disturbing the patient. The uterus, broad ligaments, round ligaments, and uterosacral ligaments were intermediate between the parietes and the viscera as regards sensitiveness to pain, slight distress being caused by the firm tying of ligatures and by traction on the tissues. In incising the uterus there is usually no pain and infiltration is not necessary. It was used in a few early cases but not lately. Removal of the child did not cause pain but sometimes caused some distress, probably from traction on the uterus, which might be unavoidable. The patient was disturbed when the assistant grasped the broad ligaments and lower uterine segment, because of the traction thus produced. It must be remembered that while the viscera are mostly insensitive to sewing, cutting, or burning, marked distress may be caused if their mesenteries or ligaments be pulled; also if the ovary be accidentally squeezed, the patient usually complains. Suturing of the uterine incision causes no pain.

I do not know to what extent local anæsthesia has been employed here or elsewhere in these operations, but I want to recommend the procedure most heartily as a life-saving measure.

One point in regard to the child; Dr. Heaney has given some attention to the question of apnœa at the time of delivery, and believes that the interval between birth and full respiration and crying is much shorter under local than under general anæsthesia and that there is less necessity for artificial respiration in these cases.

[1] Read before the Chicago Gynecological Society, November 20, 1914. (See discussion, p. 245.)

# A NEW OPERATION FOR STRICTURE OF THE RECTUM OR SIGMOID[1]

By JOSEPH WIENER, M.D., New York
Associate Surgeon Mount Sinai Hospital

STRICTURE of the rectum is either congenital, traumatic, tubercular, dysenteric, gonorrhæal, syphilitic, or neoplastic. Under traumatic strictures are included those caused by enemata. With the exception of the congenital and neoplastic, they may all be included under the general term of inflammatory. Regarding the location of the stricture, Perret reports fifty-six cases. In four it was at the anus, in thirty-two less than 6 cm. from the anus, in three at 6 cm., in seven from 6 to 9 cm., in five more than 9 cm., in five at the rectosigmoid junction.

The methods of treatment hitherto employed were:

1. *Dilatation.* Beach, in Cooke's Treatise on Diseases of the Rectum and Anus, 1914, warns against the use of sounds and bougies to determine the site and degree of occlusion, and also states that great care must be exercised in using these instruments for treatment "to avoid serious damage to the bowel, which would aggravate the pathology, besides introducing other complications . . . this may result in perforation and peritonitis." In a similar vein, Tuttle states that exploratory laparotomy is less dangerous than any instrumental examination of the rectum in diseased conditions, if the use of the pneumatic proctoscope be excepted. He further warns "against the danger of introducing rectal instruments into patients under the influence of anæsthetics; the only guide there is in regard to the amount of traumatism that is being produced lies in the sensations of the patient, and one may perforate the intestine unconsciously if this safeguard is removed." The writer has personal knowledge of three cases of perforation of the rectum due to the passing of instruments under anæsthesia. The cases were in the hands of three different competent surgeons; in each one the injury was at once recognized and the abdomen opened for its repair. One of the cases recovered promptly; the second only after a prolonged wound infection, and the third died as the result of a perforative peritonitis. Undoubtedly these cases are more common than is generally known, as the surgeon to whom this unfortunate accident happens is not very prone to publish his experience. And it was in some measure due to the knowledge of the three cases just referred to that the writer devised the operation which forms the basis of this paper. In anal stricture multiple incisions may be made, followed by gradual dilatation every few days. If the stricture is below the peritoneal reflection, forcible dilatation under anæsthesia may sometimes be attempted, although there is danger connected with this procedure. If the stricture is above the level of the levator ani, gradual dilatation may be attempted with sounds or Wales bougies, without anæsthesia, provided the stricture is not so tight that it will readily admit the smaller bougie.

2. *Linear incisions with rapid dilatation.* This is applicable only to strictures near the anus, and may result in incontinence.

3. *External proctotomy.* The incision is similar to the Rydygier-Rehn for resection of the rectum. The coccyx is removed, the stricture divided by a posterior longitudinal incision, supplemented by bougie treatment. The disadvantages of this operation are (a) danger of fistula at the point of incision; (b) the wound takes many weeks, or even months, to heal; (c) permanent local weakness and lack of support, due to the defect of bone.

4. *Rectoplasty.* This consists of a longitudinal incision with transverse suture, on the order of the Heinecke-Mikulicz pyloroplasty. It is applicable only to valve-like strictures, chiefly of congenital origin, and can be carried out only low down in the rectum.

5. *Excision.* This is rarely necessary, and is much too severe and dangerous an operation, with a mortality of almost 12 per cent.

6. *Colostomy.* This is indicated in extensive ulceration and stricture, due chiefly to lues.

7. *Lateral anastomosis* (sigmoideoproctostomy) for very high strictures imbedded in extensive adhesions.

None of the above seven methods of operating seemed the ideal procedure in the following case:

Samuel R., 63 years old, came under the writer's care in Dr. Lilienthal's service at Mount Sinai Hospital, July 15, 1914. He complained of gradually increasing asthma for the past twelve years; he had a reducible inguinal hernia for fourteen years and he had been operated on for vesical calculi five years before. Four months before admission, after becoming constipated, he had resorted to hot enemata, one of which produced a severe burn in the rectum. A few weeks later he noticed small frequent

[1] Read before the Surgical Section of the New York Academy of Medicine.

bowel movements, which soon became painful. These small frequent movements were no doubt the direct result of the formation of the inflammatory stricture. The stool was arrested at the site of the stricture, a proctitis developed, and the resulting mucus would soften a little of the stool, which would be passed at frequent intervals, together with the mucus, and accompained by considerable straining. The man's general condition was not good. He had extensive emphysema, chronic bronchitis, an enlarged heart with systolic murmur at the apex, marked arteriosclerosis, and he was somewhat cyanotic and dyspnœic. The general abdominal examination was negative. Cystoscopy showed a moderate prostatic enlargement, normal ureteral orifices, and no new growth in the bladder. A radiographic picture of the pelvis showed nothing abnormal. The Wassermann reaction was negative. On rectal examination, five inches from the anus, a hard circular infiltration was felt. It was smooth and regular, did not bleed readily, but would not admit the tip of the index finger. The tip of the smallest bougie could not be passed through the stricture. All rectal manipulation, probably due to the proctitis, was very painful. There was no rise in temperature. So we had to deal with a man of 63 in poor general condition, with a tight inflammatory stricture of the rectum rather high up, which would not admit the tip of the finger or the smallest bougie. Moreover, all rectal manipulation was very painful and the patient threatened to leave the hospital unless he could be treated without pain. The stricture was too high up to make linear incisions; any attempt at instrumental dilatation would probably have resulted in perforating the rectum; and an external proctotomy, with resection of the coccyx, would have been far too serious an operation for this debilitated old man. We finally decided to open the abdomen and be guided in our operative procedure by the pathological condition present. *Operation*, July 20, 1914. The abdomen was opened through a left rectus incision. A Wales bougie was inserted by an assistant and found to be obstructed about five inches from the anus. Repeated attempts were made to pass the bougie through the stricture, but they failed. At the site of the stricture a white scar about one inch wide was seen, completely encircling the bowel. I then requested the assistant to use considerable upward pressure on the bougie, which I had made to engage in the stricture by manipulation from inside of the abdomen. We tried this with bougies of various sizes, but were unable to pass any bougie into or through the strictured area. It then occurred to me that by forcing the bowel downward toward the anus from within the abdomen, while the assistant steadied the bougie from outside the anus, I might be able to overcome the stricture. I was a little afraid that I might perforate the bowel at the seat of the stricture, but that would have been no more serious than an incision at that point. Without using excessive effort, after a few minutes of manipulation, I could feel and see the strictured area begin to dilate, and I soon had the satisfaction of feeling the tip of the bougie in the bowel above the stricture. With a little patience a small bougie was soon passed through the stricture, or rather the rectum was "milked" over the bougie at the site of the stricture. Larger bougies were then passed and the bowel "milked" over them in like manner until the largest Wales bougie lay in the rectum above the former stricture. The bougie was allowed to remain in place and the abdomen was closed without drainage. Eighteen hours after operation the bougie was removed on account of pain. Convalescence was uninterrupted, the wound healed by primary union, and, at the patient's request, he left for his home one week after operation.

The man was requested to return every few weeks to have bougies passed. This he neglected to do, and we did not see him for over two months. In spite of this we were able to readily pass bougies high up into the rectum, although there was a slight narrowing at the site of the former stricture. On November 10, 1914, I examined the patient after he had had no bougie passed for a month. Without any difficulty I was able to pass the largest Wales bougie. The bowels moved readily without undue effort and without cathartics or enemata.

We believe we are justified in looking upon this new procedure as a valuable addition to the other procedures for overcoming inflammatory strictures of the rectum and sigmoid flexure. The operation is applicable to all such strictures more than three or four inches from the anus. Its advantages are:

1. Ease and certainty; the work is all done under guidance of the eye.
2. Absence of shock.
3. Rapid recovery; the stay at the hospital need not be much more than a week.
4. Little or no danger of perforating the rectum.

# THE BUTTERFLY RETRACTOR IN OPERATIONS ON THE GALL-DUCTS

By FRANCIS REDER, M.D., Saint Louis

A SURGEON should never become irritated at his assistant who is doing his utmost to please. There are times, however, when nothing seems to go right, and a somewhat ruffled peace on the part of the operator may be overlooked and excused. The assistant usually feels for his "boss" under such trying conditions and ignores any transitory flurry.

The upper right quadrant of the abdomen may present contingencies that come as near upsetting the sweet disposition of an operator as may be found in any other part of the human body. A satisfactory exposure of the gall-ducts usually imbues one with a congratulatory feeling. To accomplish such an exposure a good assistant is the first requisite. The assistant knows his latitude. He can do so much and no more. Instruments such as retractors, elevators, and "spreaders" are more often out of place than in place in gall-duct surgery. Sometimes, however, the right instrument properly placed will give the looked-for aid so that a satisfactory exposure can be accomplished without difficulty. The butterfly retractor, as shown in the illustration, has on a number of occasions proved to be a valuable aid in gaining a satisfactory exposure in the right upper quadrant of the abdomen.

It is a very simple instrument, with well-rounded corners, having no screws and no projections to interfere or be in the way. The instrument is both a retractor and an elevator. It is an ordinary abdominal elevator having in the main blade a notch to give additional room for the gall-bladder. Two blades are attached laterally to the main blade and these blades are simply riveted sufficiently tight to hold in any position in which they are placed.

The introduction is like that of any other retractor or elevator. Figure 1 shows the blades folded so that the introduction through the abdominal wall may be easily accomplished. The surgeon, having familiarized himself with the operative field, knows to what extent he desires the "wings" to be spread. The spreading is easily accomplished with the fingers while the instrument is held in place. Figure 2 shows retractor with wings spread.

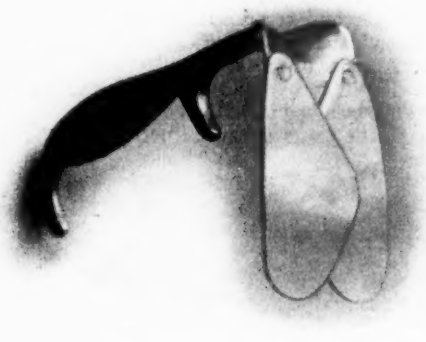

Fig. 1. Retractor with wings folded.

Fig. 2. Retractor with wings spread.

# A NEW METHOD OF LATERAL (SIDE-TO-SIDE) INTESTINAL ANASTOMOSIS

By A. L. SORESI, M. D., New York

THE purpose of the new method of lateral intestinal anastomosis described in this paper is to remedy the objectionable features common to the older methods, first, by shortening the time required to do the anastomosis, reducing the period about one-half; second, by avoiding the formation of two useless and at times dangerous cul-de-sacs; and third, and most important of all, by forming an anastomotic opening which has no tendency to become occluded, and which, because of its shape and size, is better suited for the passage of the intestinal contents than the opening obtained by the older methods. The technique is as follows:

After the usual preparation of the intestines the two stumps which are to be anastomosed are brought in contact, the cut edges in opposite directions (Fig. 1). A strand of any suture material, preferably silk, about 40 cm. long, on which two round needles have been threaded (the choice of the needles depends on the operator — the author always uses plain seamstress's needles No. 7), is used for a seroserous suture in the following manner: The suture is started midway between the two cut edges of the intestine, about 2 mm. from the attachment of the mesentery. One of the two needles is used to start the suture and the stitches are taken toward one of the cut edges up to a distance of approximately 3 mm. from the same.

A like procedure is followed with the other needle in the opposite direction. The two ends of the thread are gently pulled apart, but are held parallel with the suture line to insure a perfect approximation of the serous surfaces. The ends are dropped temporarily and will be used later. With a pair of scissors the two stumps of the intestines are cut longitudinally and parallel to the seroserous suture, approximately 3 mm. from it. Two needles are threaded with one strand of chromic or iodized catgut No. 1. A suture intersecting the three coats is started just about opposite the point of the beginning of the seroserous suture, and is continued completely around, halfway with each needle, until the intestine is completely closed. The two ends of the catgut are then tied with two knots—the first one being a surgical one — and the catgut is cut short. The two needles which had been used to start the seroserous suture are picked up and the two ends of the silk again pulled gently as described above. The suture is continued, half-way with each needle, until the two needles meet, when the thread is tied and cut close.

The author strongly recommends the use of catgut for the through-and-through suture, because unabsorbable material might be the nucleus for the formation of calculi, which in time might even occlude the lumen of the gut—a fact demonstrated by the author in another paper.

As is readily seen from the illustrations, the completed anastomosis appears more like an end-to-end than a side-to-side anastomosis. The opening between the stumps is very large — in fact, larger than the normal lumen of the intestines that have been anastomosed — and the intestinal contents follow a normal course without detour. By examining the illustrations we also see that the opening between the stumps is different from the opening obtained in other methods of anastomosis. The original natural size and shape of the lumen are preserved, for where the stumps come together they are united in a slanting way so that each forms half of the larger new lumen without altering the lumen where the anastomosis begins in each stump of the intestine. By this arrangement the possible retraction and following constriction caused by scar-tissue could not affect, in any sensible way, the lumen of the anastomosis. In other words, the anastomosis is made by overlapping the two stumps of the intestine which have been cut wide open, doubling the size of the gut at the point of the anastomosis, so that any probable constriction could not cause any appreciable narrowing of the new lumen of the intestine. The author would call attention to the fact that the illustrations are exact reproductions of the specimens and portray the operation step by step. The photographs have not been even slightly retouched.

The illustrations show so plainly the different steps of the anastomosis that any surgeon should be able to master the technique. It should be strongly advised, however, that the procedure be tried first on the cadaver or, better, on living animals; for, before attempting the operation on a patient, the surgeon should be the absolute master of all, even the little, details of technique; and these details, peculiar, perhaps, to the surgeon who has originated the technique, cannot all be

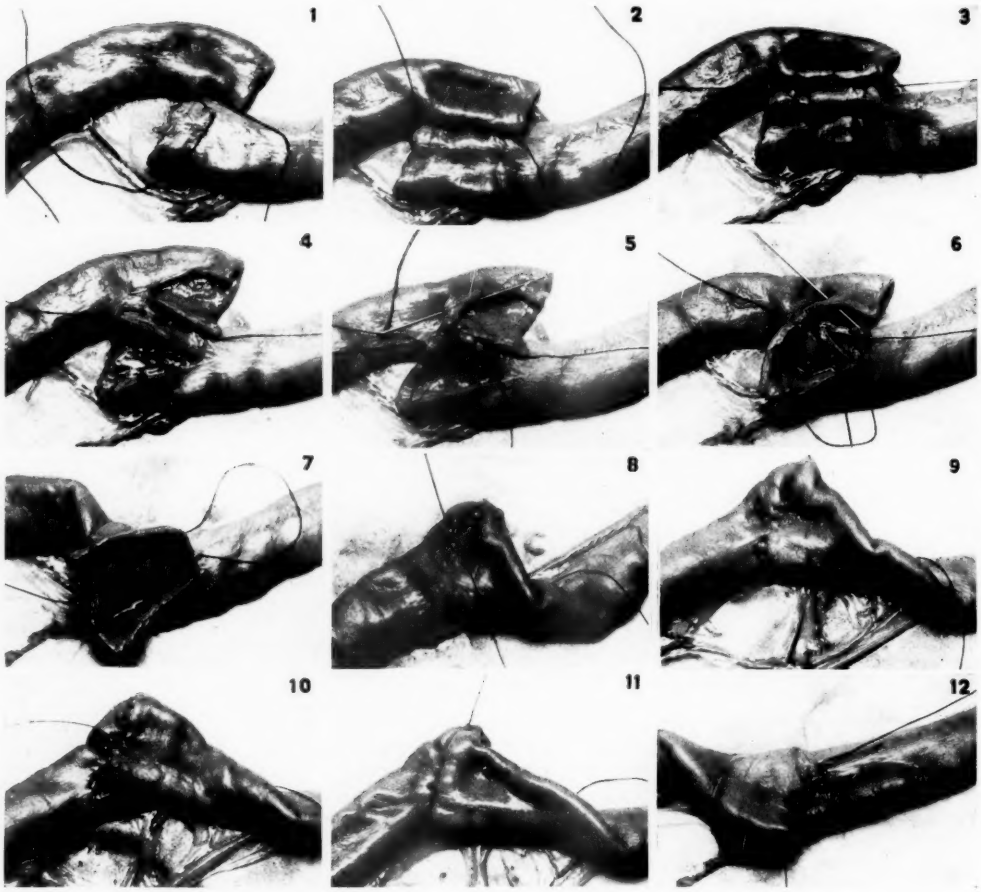


Fig. 1. Approximation of the two stumps of intestine and starting of the seroserous suture.

Fig. 2. First part of the seroserous suture finished, each thread coming out at about 3 mm. opposite the cut edge of the other stump.

Fig. 3. How the thread should be pulled so as to closely approximate the serous surfaces without injuring them.

Fig. 4. The thread used for the seroserous suture is dropped and the two stumps of the intestine are cut up to a distance of about 3 mm. from the cut edge of the other stump and about 3 mm. from the seroserous suture.

Fig. 5. Beginning of the through-and-through suture with the needle at the left of the operator, showing how to deal with the angle made by the incision.

Fig. 6. Continuation of the suture begun in Fig. 5.

Fig. 7. The needle used in Figs. 5 and 6 is dropped, the other needle is picked up, and the through-and-through suture is continued in the same manner as in Figs. 5 and 6, with the intestine on the right of the operator, until the two sutures meet as shown in Fig. 8.

Fig. 8. Ending of the through-and-through suture, each thread emerging on the serous surface of the opposite stump. The thread must be gently pulled so as to make the suture taut before tying the knot as shown in Fig. 9.

Fig. 9. The through-and-through suture is finished, the knot tied, and the surgeon is ready for the seroserous suture, after having again closely approximated the serous surfaces by pulling the thread as shown in Fig. 3.

Fig. 10. Beginning of the seroserous suture; the thread is left loose in order to show how the suture is made; but in the actual operation it must always be kept taut as shown in Fig. 11, so that no thread is seen between the approximated serosa of the stump of intestine.

Fig. 11. About half of the seroserous suture finished; the needle is dropped.

Fig. 12. After having made about half the suture as shown in Fig. 11, the intestine is turned on the other side and the other needle finishes the seroserous suture, in the same manner as done for the other half.

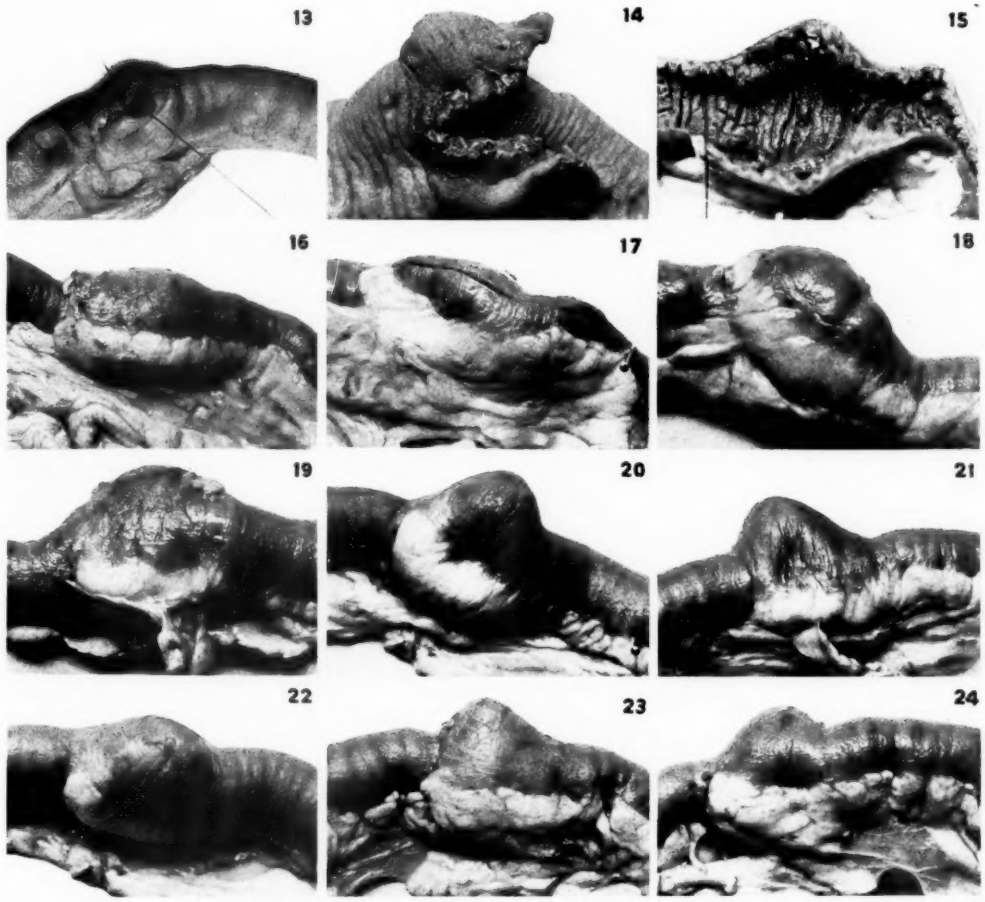


Fig. 13. Seroserous suture finished; the two threads emerging from the opposite stump of the intestine ready to be tied. Anastomosis completed.

Fig. 14. Showing suture line inside the intestine.

Fig. 15. Appearance of inside of anastomosis six months after the operation.

Figs. 16 and 17. Outside Appearance of same specimen.

Figs. 18 and 19. Appearance of another specimen seven months after the operation.

Figs. 20, 21, and 22. Three views of another specimen eight months after operation. In this and in specimen shown in Figs. 23, and 24, the lines of the anastomosis can be seen very plainly; it can be seen how the two stumps form a new portion of intestine larger than each stump, leaving at the same time the natural lumen of both stumps of the same caliber as before the operation.

Figs. 23 and 24. Two views of another specimen eight months after operation.

described in any paper nor can the technique be mastered simply by reading a description of the method. It is necessary that the method be tried on the cadaver or on living animals that the many little difficulties may be mastered. It is a mistake too often made that a new procedure is tried on patients, and this is not fair either to the patient or to the originator of the method; for, especially if the result is not satisfactory, the method is likely to be discarded, simply because the surgeon had not mastered his technique and is therefore working under a great handicap in attempting to do the operation for the first time on a patient with a human life at stake.

# THE TREATMENT OF UNDESCENDED TESTIS

## Some Suggestions and Modifications in the Surgical Technique

By JOHN A. WOLFER, M. D., Chicago
Instructor in Surgery, Northwestern University Medical School; Associate Surgeon, Cook County Hospital; Assistant Surgeon, Wesley Memorial Hospital

IT is not the purpose of this communication to discuss in any way the theory for non-, partial, or maldescent of the testis or to give reasons why a testicle should be placed in its normal position. Under certain conditions it may be deemed necessary by the surgeon to place a testis in its normal anatomic location. In some instances, especially in patients about or just before the age of puberty, it is possible to place the testis in the scrotum by simply freeing it from the spermatic structures, liberating the cord and placing it in a pocket in the scrotum, the whole operation being practically that of the Bassini operation for the cure of inguinal hernia. In other cases, as in adults or when the cord is short, it becomes impossible to bring the testicle down and if tension is used, the testis usually becomes painful and begins to atrophy, and sooner or later we find a small, tender, and useless organ lying just outside of the external ring, or it may even retract again into the inguinal canal. In such cases the testis gives the patient more distress than it did before the operation.

By using the technique of Bevan (1), that is, cutting the spermatic artery, there is no question

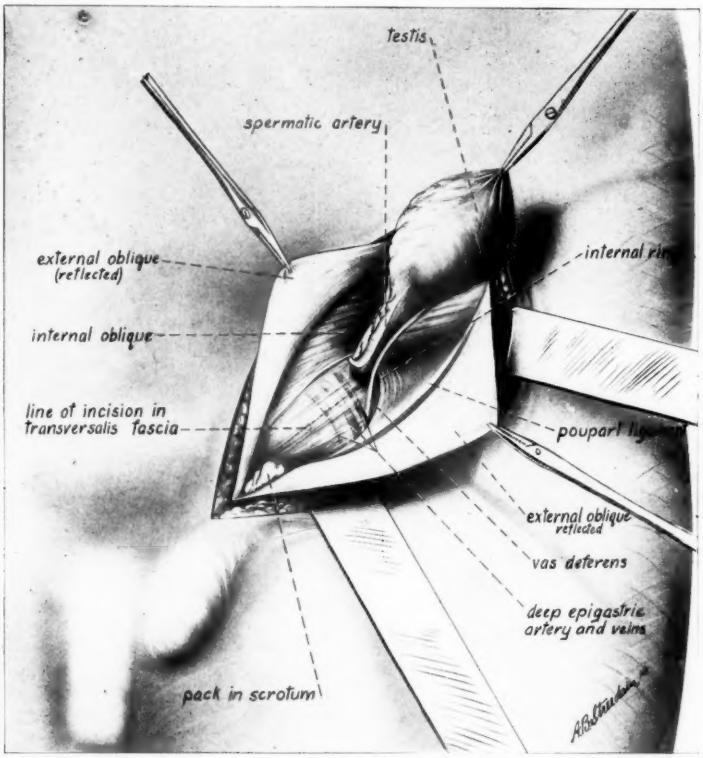


Fig. 1.

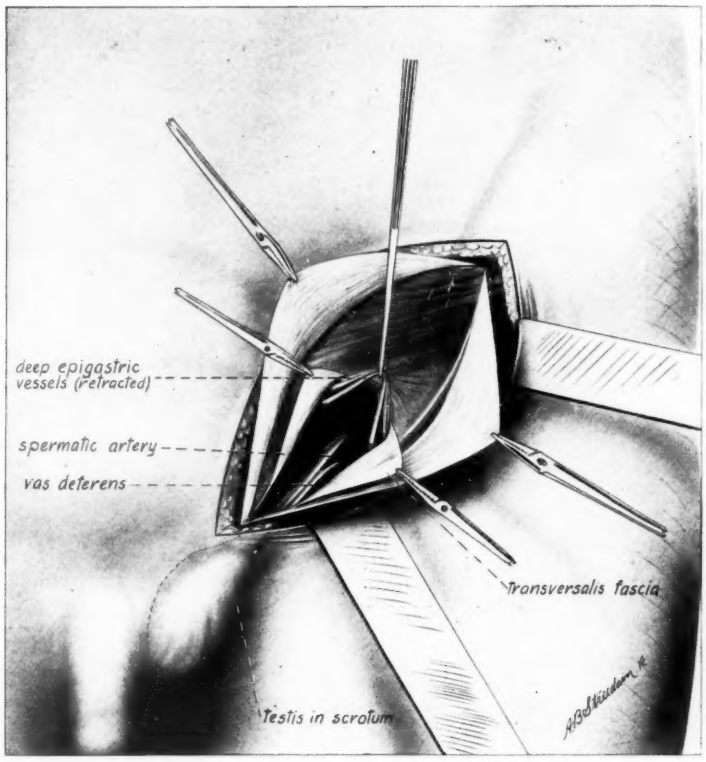


Fig. 2.

but that a testis can be placed in the scrotum with ease, and it will remain in position; but here we are grossly trespassing on anatomic and physiologic grounds. As shown by Moschcowitz (2) and others, certain degenerative changes take place. I feel that this is not produced entirely by insufficient blood-supply, but by interference with the innervation to such a highly organized structure. Clinical observations and a study of the pathology lead me to believe that in such an organ, even though the microscope reveals no areas of focal necrosis or areas of fibrosis, the cells may undergo changes which cannot be readily seen. The internal secretion is diminished or changed and the spermatozoa, although numerous and active, lose their procreative properties. One cannot say that double undescended testes after operation have been restored to function because the patient is able to procreate. My personal attention has been called to an instance of a child who has double undescended testes and whose father had double undescended testes which had never been operated upon The question then arises whether it is better to have a functional, active testis in the abdomen or one replaced which may or may not functionate.

Davison (3) overcomes to some extent some of these obstacles. He leaves the spermatic structures intact, cuts the deep epigastric vessels and advances the internal ring toward the median line. He places the spermatic structures, which Bevan cuts, around the bulge of the peritoneum, thus using the hypothenuse of the triangle instead of the sides. But here again we interfere with the more or less essential anatomy of a part. Why cut the deep epigastric vessels when not necessary? This artery supplies a portion of the anterior abdominal wall and, although collateral circulation is good, yet certain changes must necessarily take place. We must, as surgeons, begin to look upon anatomic structures

Fig. 3. 542,250, H. K., age 12. Right testicle was never seen or felt by the patient or his parents. At times there appeared a small mass in the inguinal region at the internal ring, which would disappear when lying down. Hernia on the left side. Operation June 6, 1914. Double congenital hernia. Right testicle within the internal ring. Picture taken two and one-half months after operation. Testis, although higher than the left, is freely movable and well within the scrotum.

Fig. 5. Same patient as Fig. 4, nineteen days after operation. Upon operation the right testis was found in the inguinal canal, left testis in the abdomen and firmly fixed. Patient has considerable œdema about the site of the operation; this causes the fullness about the upper part of the scrotum. Each testis is well in the scrotum, freely movable, and not tender.

Fig. 4. 543,326, P. McD., age 30. Neither testis had ever been in the scrotum. Right testis about midway between the internal and external rings of the inguinal canal, and very tender. Left testis never felt in canal. No scrotum whatever.

with some degree of seriousness, and not remove or destroy them—unless, of course, it becomes of vital importance to the patient—simply because in our present rather narrow field of vision we see no harm in doing so. No doubt both deep epigastric arteries may be cut; but are we justified in doing so?

This later question aroused in me the interest in trying to find some way to preserve these essential structures and yet replace a testicle. The following suggested itself:

The inguinal canal is opened as in the Bassini operation for the cure of inguinal hernia. A pocket is then prepared in the scrotum by stretching the parts with the fingers and packing a large piece of gauze into this fossa, leaving it in position until the testis is prepared. The testis is then found, and here, at times, some difficulty is encountered. If the organ lies within the internal ring, it may be hard to reach. The ring may have to be enlarged, but usually the testicle can be delivered by picking up and freeing the structures emitting from the internal ring —the remnant of the gubernaculum ligament— using gentle traction on them and pressure on the abdomen just above the inguinal region. The cord is then freed, separating the vas from the rest of the structures. It will be readily seen that the vas leads downward and to the median side while the other structures lead upward and outward.

The deep epigastric vessels, usually two veins and the artery, are readily found lying in the

transversalis fascia, just median to the internal ring (Fig. 1). By blunt dissection these vessels are easily freed and held out of the way with a blunt hook. The transversalis fascia is then cut down to the pubes. The testis is drawn behind the deep epigastric vessels. The vas will now follow down behind Poupart's ligament. The structures which extend upward and outward are freed from the peritoneum and dealt with as in the Davison operation—pushed behind the bulge of the peritoneum. Here care must be exercised, as quite often the peritoneum is thin and easily torn. Again, when a hernial sac is present and it has been excised, the ligature may tear off by tension and the peritoneum is torn before one becomes aware of the fact. Congenital herniæ quite often are found associated with undescended testes. In these the sac is separated from the spermatic structures and enough of it is reserved to make a tunica vaginalis for the testicle, the rest being ligated and excised. When by posterior displacement of the spermatic structures, sufficient length has been given the cord to allow the testis to be placed in the lower part of the scrotum, the gauze pack is removed from the scrotal fossa and the testis placed in the pocket prepared for it (Fig. 2).

In doing this operation three times, I have not found it necessary to fasten the testis in the scrotum aside from placing a catgut suture from the periosteum and tissues over the pubic spine to the inner border of Poupart's ligament; in other words, the testis is simply retained in the scrotum by obstructing the scrotal outlet. Instead of using fascial flaps to enlarge the scrotum as suggested by Thompson (4), I simply insist on the patient massaging and stretching the tense wall several times daily after the wound has healed, thus giving the testis ample room.

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# SUBPERIOSTEAL OSTEOTOMY OF THE OS CALCIS FOR PES CALCANEUS

## Report of Two Cases

By WILLIS C. CAMPBELL, M.D., Memphis, Tennessee

PES CALCANEUS is of much less frequent occurrence as an end-result of anterior poliomyelitis than calcaneovalgus, while calcaneovarus is extremely rare. It is not my purpose to discuss the causative mechanism of cavus, which is always associated or a part of calcaneus, but it is well known that if the muscles forming the heel-cord become paralyzed when other muscles of the foot remain active, there is a loss of muscle balance, and the intrinsic muscles of the sole and plantar flexors approximate the forefoot and the heel elevating the arch (cavus). The os calcis is drawn forward so that it may be perpendicular and in direct line with the bones of the leg, and the forefoot a mere appendage. The normal posterior contour of the heel is completely obliterated, the posterior surface of the leg and heel being on the same plane, the weight being borne on the posterior extremity of the os calcis. A similar deformity, though not paralytic, is found in the Chinese female foot, which has been bound in infancy.

Treatment of calcaneus by forcible correction with fasciotomy may improve, but is far from satisfactory. Jones has devised a two-stage operation, which gives better results, but it is often difficult in this country to obtain permission for one operative procedure. Whitman's astragalectomy is an excellent procedure when lateral displacement is associated as calcaneovalgus. I have devised a simple procedure for calcaneus which has given excellent results in two cases herein reported.

The technique is as follows: A skin incision is made from the tip of the external malleolus parallel with the long axis of the os calcis, and the fascia is incised in the same line exposing the peroneal tendons. The peronæus longus is drawn out, severed, and each end clamped. The periosteum is next incised and retracted. With a chisel a wedge is removed, beginning just behind the posterior facet for articulation with the astragulus, sloping obliquely downward and forward (as the os calcis is more or less perpendicular in this condition) to within a fraction of an inch from the inferior surface, and then directly

Fig. 1.

Fig. 2.

Fig. 1. Case 2 prior to operation.
Fig. 2. Case 2, six months after operation, showing elongation of foot, proper distribution of weight-bearing, and obliteration of cavus.

backward at right angles to the long axis. After removal of the wedge, the size of which depends upon the degree of calcaneus, one can easily approximate the raw bony surfaces without causing complete fracture. Subcutaneous section of the plantar fascia may be necessary. The proximal end of the peronæus longus is transferred and fixed through a tunnel in the bone just anterior to the insertion of the tendo Achillis, using heavy silk. The distal end is attached to the peronæus brevis, the wounds closed with plain catgut No. 0. A cast is applied from toes to knee, with foot in marked equinus. No dressing is needed for six weeks, after which walking is permitted with an elevated heel to shoe, in daytime, and at night a splint is applied to continue the equinus position for several months to avoid injury to the new insertion of the peronæus longus and to allow contraction of the overstretched heel-cord. Weight-bearing is thus brought forward to the posterior inferior aspect of the os calcis, the exaggerated arch lowered and the normal posterior protuberance of the heel restored, actually elongating the foot. The transferred peronæus longus cannot be expected to replace the triceps suræ, but it may to some extent restore the function of this group.

The essential facts in the history of two cases are as follows:

CASE 1. Girl, age 12. Common type of poliomyelitis affecting both lower extremities at the age of four. Right entirely recovered within one year, but the child continued to limp in left foot and the foot became deformed. Examination: Right lower extremity apparently normal; calcaneus of left foot; marked cavus; paralysis of left gastrocnemius and soleus; tendo Achillis stretched and lengthened; all other muscles of leg and foot unaffected. Inversion, eversion, dorsal flexion, and toe motion normal. Plantar flexion alone deficient. October 10, 1913, operation as above described; recovery uneventful. Patient has borne weight since December 1, 1913. Heel of shoe raised one inch for three months, after which one-half inch, and at present the patient wears a simple orthopedic shoe. The result has been permanent, the foot actually elongated, cavus reduced, and weight-bearing more evenly distributed.

CASE 2. Boy, age 17. Poliomyelitis when two years old; recovery of function except in left foot as in Case 1, and the extensor propius policis which remained paralyzed causing subluxation of the first phalanx at metatarsophalangeal joint of great toe. January 15, 1914, arthrodesis of the metatarsophalangeal joint relieved disability at that point; otherwise procedure as above described. Function has decidedly improved, and the patient has taken up dancing. Actual elongation of entire foot is quite apparent; weight-bearing has been brought forward and properly distributed. The only disability remaining is weakness in the heel-cord which seems to be improving with careful exercises.

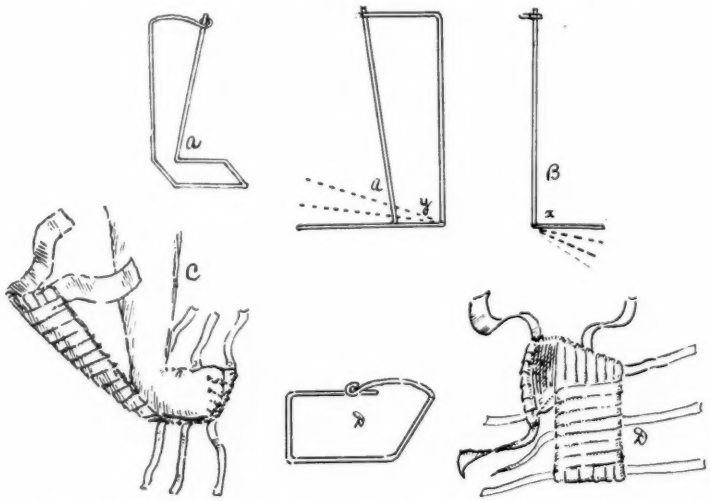
Sufficient time has not elapsed to determine that the result will be permanent. However, as each one is apparently improved at the present time, I feel justified in reporting both cases.

I have not used this method in combination with tendon transplantation for paralysis of peroneal or tibial group, as I regard other procedures far more successful. The operation should under no circumstances be done except in cases of simple pes calcaneus.

# WIRE SPLINT IN THE EARLY TREATMENT OF CONGENITAL CLUB-FOOT

By A. J. DALTON, M.D., St. Joseph, Illinois

I CLAIM no priority in the use of wire splints in the treatment of certain cases of congenital club-foot, especially talipes varus and equino-varus, but I wish to present a splint which has proved satisfactory in my hands. Non-surgical treatment of this deformity usually implies the use of plaster casts, and while I do not wish to cast any reflection upon the use of this material, yet I think the wire offers advantages which cannot be had with the plaster.




Splint made of No. 8 galvanized wire. a,a, lateral view; b, posterior view; c, foot piece to be strapped first, then leg piece to be pulled into position; d,d, looking from above down on padded splint.

The accompanying illustrations show how this splint is made. Number eight galvanized wire is used and bent to suit each case as to size. The angle "x" is about 90° for first application, and this is gradually increased at subsequent treatments until the inversion is overcorrected to a satisfactory degree; the angle "y" is also at about 90° for first application, and is gradually lessened at each succeeding treatment until the equinus is overcorrected.

The splint is well padded and then wrapped with one-half to one inch bandage. Several strips of "ZO" adhesive plaster, one-half inch wide and six to eight inches long and one strip two inches wide and long enough to wrap around the splint at the calf, are prepared. The limb is bathed in alcohol and dried, after which the foot is firmly strapped to the foot piece of the splint, then the upright part of the splint is fastened to the leg at about two inches from the knee-joint; a smooth fitting bandage is applied, and adhesive strips hold bandage in place.

If the deformity is not seen early, it would probably be necessary to manipulate foot before applying the splint. The splint can be changed every two to three weeks, but the limb must be bathed with alcohol each time to prevent any irritation from the adhesive.

The splint offers the following advantages: The skin can be inspected every few days if necessary. There is marked leverage to overcome the deformity of varus, equinus, either one or both. There is practically no tendency to necrosis. The splint is light and comfortable.

# CARE AND FEEDING OF INCUBATOR BABIES[1]

By CLIFFORD G. GRULEE, M.D., Chicago

ALL who have written upon the subject of infant mortality agree that the period when the death rate is highest is that of the first few weeks, and especially the first week of life. The high death rate at this period is largely attributable to prematurity. This is perhaps best shown by the figures of Kerness. His statistics were taken from the University Gynecological Clinic at Munich. Of 10,297 births which occurred between the first of October, 1907, and the first of October, 1911, there were 149 abortions and 538 stillbirths. Of the remaining 9,610 children born alive, 248 died, of which only six lived longer than eight days. Of the 242 which died within the first eight days, 181, or almost exactly three-fourths, were premature infants. Of these 181 cases the deaths in 140 cases were judged to be due to congenital debility, a condition which offers no pathology except that of underdevelopment. It will be seen, therefore, how important it is for the purpose of the reduction of infant mortality to study carefully the conditions which present themselves in premature infants, and in so far as possible to combat these conditions successfully. It is for that reason that I wish to present to you a report of the eight premature babies which have come under my care at the Presbyterian Hospital since December 31, 1913. I have omitted from this list no premature infants which were in that hospital under my care during this time. I must apologize for the fact that the number is so small, but I hope that some of the points to be emphasized may be brought out by even so small a series of cases.

Baby Im., 3 days old, entered the Presbyterian Hospital on December 31, with a diagnosis of congenital debility. The child was one of twins, at about seven months. The first child was a breech presentation and forceps had been used on the after-coming head. This child was dead and apparently had been dead for some time, according to the report of the father. The second twin, the one concerned in this report, was born in a very few minutes after the first. According to the father, she shot out with great force and "yelled lustily" right away. She was too small to nurse so he fed her with some sugar water, giving a little with a spoon every three hours. Evidently she urinated freely from the first. On physical examination there was nothing specific to be noted.

The child, on the morning of the first day of January, weighed 2 pounds 1 ounce; temperature, 96.2°F. It was put in the incubator, the temperature remaining continuously low until about February 1, when it began to be more regular and normal. This child was put on four-hour interval feeding, starting with a half-ounce of breast milk and gradually increasing until on the day of discharge, March 4, it was getting 3 ounces six times a day, the weight increasing during that time from 2 pounds 1 ounce to 4 pounds 2 ounces. The child left the hospital in excellent condition.

During this time, in the early days, the child repeatedly regurgitated but never all of its feeding. The feeding was mostly by gavage. The regurgitation gradually decreased so that at the end of two weeks the child regurgitated perhaps once in two or three days. The stools were normal and the course altogether uneventful. As the chart will show, the only break of any consequence in the steady gain in weight was within the last four or five days before discharge.

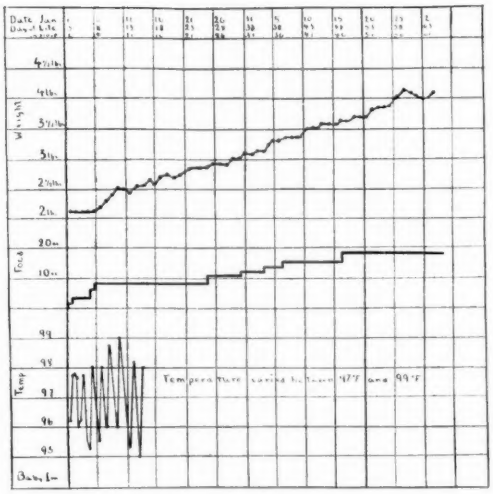
According to the father's statement, the baby at 10 months of age was twenty-six inches long, seventeen inches around the chest, and weighed sixteen pounds. She was able to stand and could walk a little if assisted.

Baby F., born February 3, 1914. The mother entered the hospital having a severe pain in the abdomen which had been diagnosed as possible intussusception. On opening the abdomen the fœtus was found free in the abdominal cavity. The mother died almost immediately after the operation. Estimation of the age of the fœtus was not given. The child thus delivered weighed 3 pounds 9 ounces. It lost steadily from the date of birth and died on the fifth day, having lost 9 ounces. On the fourth day after birth the temperature rose to 103.4°F., to drop almost immediately to 96°F. The cause was not apparent. This child was given breast milk to the amount of ½ ounce every four hours. It vomited frequently without any apparent symptoms other than those previously mentioned. It died early on the morning of the fifth day.

Baby Iv., born March 16, 1914. The child was delivered by cæsarean section by Dr. Webster because of nephritis of pregnancy of the mother. The mother was a primipara. This child was almost at term. The child was put to the breast every four hours after the first twenty four hours but refused to nurse on the fourth day, so was given breast milk—an ounce and a fourth to two ounces, every four hours until the fifteenth day. The food was then changed to 15 ounces of albumin milk and ¾ ounces of dextri-maltose and 3 ounces of water, six feedings of 3 ounces each every 4 hours. On April 5 this was increased to 16 ounces of albumin milk,[2] 1 ounce of dextri-maltose, and 2 ounces of water. The child at birth weighed 6 pounds and dropped to 5 pounds 4½ ounces. Up to March 29 the gain was very slow, so that by that time it lacked 2 ounces of having regained this initial loss. From that time up to April 7 the child gained up to 6 pounds 8½ ounces, a gain of 10½ ounces in nine days. The child then left the hospital continuing on the same formula. On April 14 the child weighed 7 pounds; on the 27th, 7 pounds 7 ounces, the formula continuing about the same. The temperature in this case did not remain below normal for any length of time and

[2] Albumin milk: One quart of albumin milk = the curds of a quart of whole milk mixed with a pint of buttermilk made from fat-free milk and the whole made up to a quart with sterile water.

[1] Read before the Chicago Gynecological Society, November 20, 1914. (See discussion p. 248.)



its stay in the incubator was short. From recent accounts this child at nine months is a perfectly strong healthy baby.

BABY M., born May 11, 1914, by cæsarean section carried out by Dr. J. C. Webster. The child was a seven-months' baby and weighed at birth 3 pounds 10 ounces. It dropped so that on the sixth day its weight was 2 pounds 15 ounces. It was necessary from the start to feed this child artificially so that for the first month the child received only artificial food. We began with six feedings of 1 ounce of albumin milk each on the third day. To this was added ¼ ounce of dextri-maltose in the six feedings on the ninth day. This was further increased until by the end of the first month the child was getting 9 ounces of albumin milk, ½ ounce dextri-maltose; six feedings of 1½ ounces each. On June 11 when the artificial feeding was stopped the child weighed 3 pounds 7 ounces, just 3 ounces less than its birth weight. From then on it was fed on breast milk, starting out with six feedings of 2 ounces each, varying up and down, so that on July 19 the child was getting six feedings of 2¾ ounces each. During this time the child had gained from 3 pounds 7 ounces on June 11 to 4 pounds 2 ounces on July 19, a gain in thirty-nine days of only 11 ounces. The child was then shifted to artificial food, the amount being gradually increased until on August 3 it was getting 13 ounces of albumin milk, 1 of dextri-maltose, and 5 of water; six feedings of 3 ounces each. During this time the child had a weight curve which was very peculiar. It rose from 4 pounds, 2 ounces to 4 pounds 8½ ounces on the 29th, a gain of 6½ ounces in a week; then from July 29 to August 4 it lost again down to 4 pounds 5 ounces. On August 4 the food was again reduced to 12 ounces albumin milk, ¾ ounce dextri-maltose, and 6 of water. The child continued to lose until on August 7 the weight had reduced to 4 pounds 3 ounces. Then it had an up-and-down course until on the 12th it was again given part breast milk and part albumin milk. This was continued with much success until the first of September, when the child was again put on albumin milk on which it did very well but lost slightly when the albumin milk was changed to Albuco (a preparation of evaporated albumin milk which it is possible to use in the home). This child at no time showed a marked subnormal temperature.

BABY MORRIS

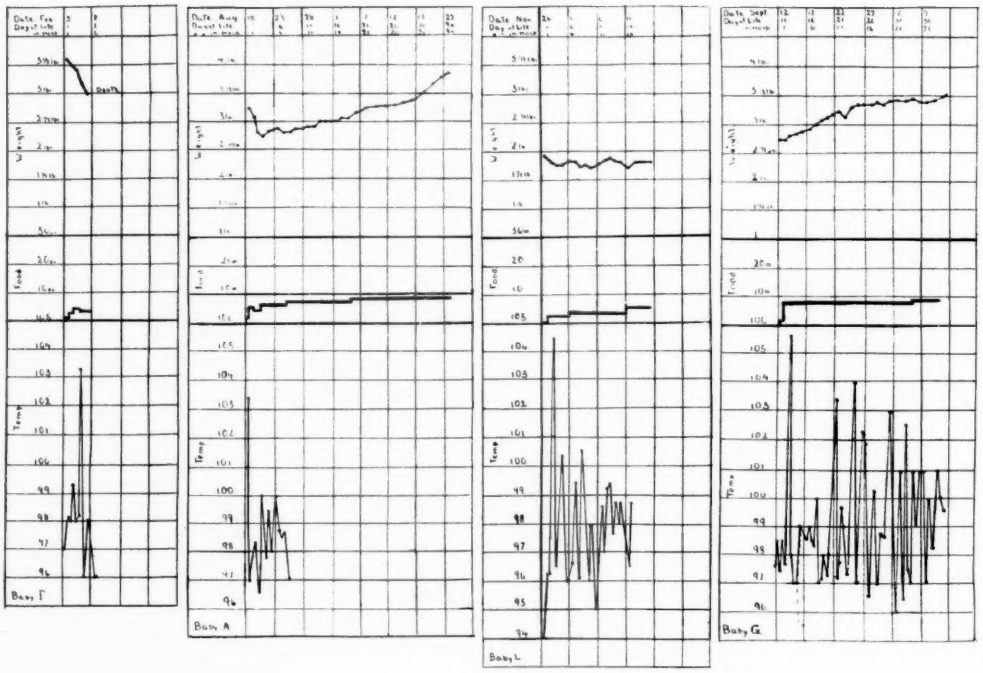
| Date of Feeding | Albumin Milk | Dextri-maltose | Water | Breast Milk | Number Feedings in Twenty-four Hours | Intervals During Day | Intervals During Night | Amount of Each Feeding |
|---|---|---|---|---|---|---|---|---|
| 5–13 | 6 | .. | .. | .. | 6 | 4 | 4 | 1 |
| 5–20 | 6 | ¾ | .. | .. | 6 | 4 | 4 | 1 |
| 5–25 | 6 | ½ | .. | .. | 6 | 4 | 4 | 1 |
| 5–28 | 7½ | ½ | .. | .. | 6 | 4 | 4 | 1¼ |
| 6–10 | 9 | ½ | .. | .. | 6 | 4 | 4 | 1½ |
| 6–12 | .. | .. | .. | 12 | 6 | 4 | 4 | 2 |
| 6–15 | .. | .. | .. | 15 | 6 | 4 | 4 | 2½ |
| 6–27 | .. | .. | .. | 18 | 6 | 4 | 4 | 3 |
| 7–5 | .. | .. | .. | 15 | 6 | 4 | 4 | 2½ |
| 7–8 | .. | .. | .. | 12 | 6 | 4 | 4 | 2 |
| 7–9 | .. | .. | .. | 13½ | 6 | 4 | 4 | 2¼ |
| 7–15 | .. | .. | .. | 15 | 6 | 4 | 4 | 2½ |
| 7–19 | .. | .. | .. | 16½ | 6 | 4 | 4 | 2¾ |
| 7–23 | 12 | ½ | 6 | .. | 6 | 4 | 4 | 3 |
| 7–24 | 12 | ¾ | 6 | .. | 6 | 4 | 4 | 3 |
| 8–1 | 13 | ¾ | 5 | .. | 6 | 4 | 4 | 3 |
| 8–3 | 13 | 1 | 5 | .. | 6 | 4 | 4 | 3 |
| 8–4 | 12 | ¾ | 6 | .. | 6 | 4 | 4 | 3 |
| 8–12 | 8 | ¾ | 4 | 6 | 6 | 4 | 4 | 3 |
| 9–1 | 12 | 1 | 6 | .. | 6 | 4 | 4 | 3 |
| 9–3 | .. | .. | .. | 18 | 6 | 4 | 4 | 3 |
| 9–7 | 15 | ¾ | 9 | .. | 6 | 4 | 4 | 4 |

On the sixth day the temperature was down as low as 96°F. but soon rose again. The variation in temperature was not any more marked than was usual with an incubator baby. This variation ceased by the end of the first month and by the middle of the first month the temperature was about normal.

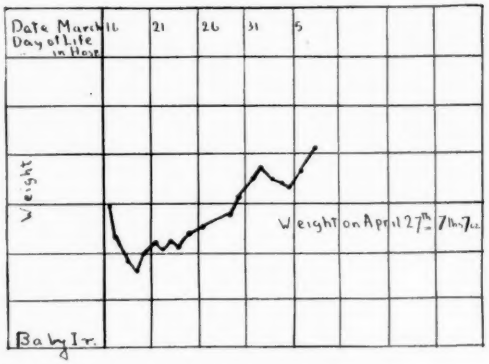
Most interesting in this case, however, were the urinary findings. On May 14, the fourth day of life, the urine was examined and found to contain not only nucleo-albumin, but a very large amount of serum albumin and leucocytes. On the strength of these findings a bad prognosis for the child was given. This albuminuria continued; a week later there were still traces of albumin and this continued regularly until June 15, or until the child was about five weeks of age. As to the nature of this albuminuria it would be pretty hard to say, though it seems altogether likely that in this case the kidneys were affected in very much the same manner as were the kidneys of the mother, the toxæmia affecting the mother probably having a like effect on the child. It seems to me for this reason that it is quite remarkable that this child lived.

BABY A. was a private case of Dr. Roberts, born at seven months in normal labor, on August 18, 1914. At birth the child weighed 3 pounds 3 ounces; the initial drop was to 2 pounds 12½ ounces, the latter point being reached on the fourth day. From then on the child gained regularly so that on the day it left the hospital, September 22, at five weeks of age the child weighed 3 pounds 14½ ounces, a net gain from birth of 11½ ounces. This child showed very few disturbances of temperature. It was fed at four-hour intervals with breast milk, beginning on August 21 with 6¾ ounces, in six feedings of 1⅛ ounces each after it was found that the mother secreted no breast milk. This was increased so that at the time it left the hospital the amount was six feedings of 1½ ounces each. This child, like most of these infants, regurgitated a little the first few days. This became very slight so that by August 23 only one regurgitation is mentioned. The child made an uneventful recovery and left the hospital in good condition.

INFANT G. entered the Presbyterian Hospital on my service on September 12, aged eleven days. No definite history as to the degree of prematurity to be noted. The child on entrance weighed 2 pounds 12 ounces; the tem-



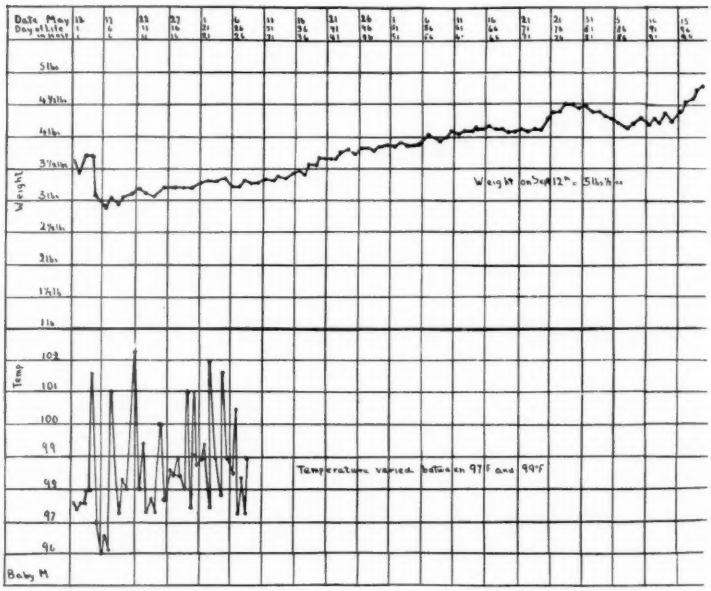

perature was slightly subnormal. On the third day the child very suddenly shot up a temperature to 105.6°F., which fell almost immediately. It was altogether likely that the incubator at this time became very warm. The temperature of this child became quite irregular and we were not able to control it as we wished. The child left the hospital on October 10, at the age of thirty-nine days. The weight at that time was 3 pounds 8½ ounces, a gain in four weeks of 12½ ounces. This child was fed at four-hour intervals, being given on entrance 1¼, later 1½ ounces of breast milk at each feeding. No regurgitation is mentioned in this case. The urine in this instance, two days after entering, contained a small amount of nucleo-albumin, and five to six leucocytes to the field in an uncentrifuged specimen. This to a degree might account for the uneven temperature, but by us it was considered of no great significance.




BABY P. was born at the Presbyterian Hospital on September 22, 1914, on the service of Dr. Webster. The child was premature, being estimated to be six and one-half months. The presentation was a breech. Most interesting in this case is the fact that in four previous pregnancies the mother had miscarried every time about the third month. So far as we could find there was no syphilitic taint. This baby at birth weighed 2 pounds 8 ounces and decreased so that on the seventh day it reached its lowest weight of 2 pounds 3 ounces. It is still in the hospital[1] having gained from September 29 to November 17, 1 pound 5½ ounces, its weight on November 17 being 3 pounds 8 ounces, a net gain of 16½ ounces in fifty-seven days. The temperature in this case has been very irregular, but is becoming more and more nearly normal; the infant has been taken out of the incubator and is ready to go home. The child in the beginning was given six feedings of 1 ounce each of breast milk and this was increased to 1½ ounces; regurgitated a little at first. This lasted only a short time and the condition at the time of writing was excellent.

BABY L. was born on the service of Dr. Webster at the Presbyterian Hospital on October 26, 1914. Breech presentation but normal birth; second child, both premature; the other died. It was not possible to determine the exact fœtal age. At birth it weighed 1 pound 15 ounces and the initial temperature was 94°F. This child has shown a marked variation of temperature while in the

[1]Patient left the hospial November 21, 1914.

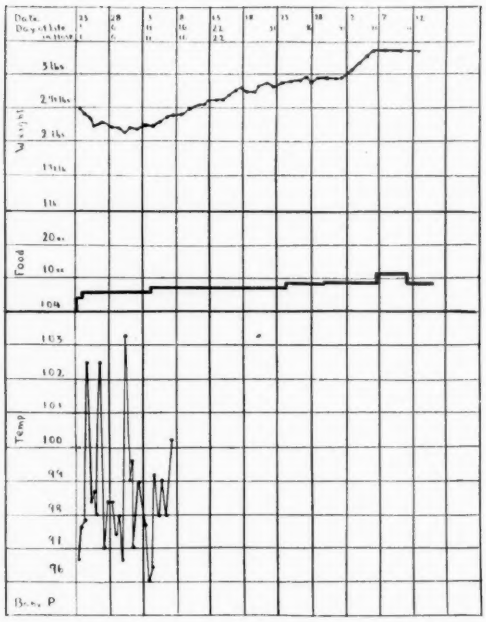



incubator, from 95°F. to 104.5°F. The weight dropped as low as 1 pound 12 ounces on the eighth day. It has since risen to 1 pound 15 ounces on November 19, the twenty-fifth day of life. What the ultimate result will be in this case yet remains in doubt, though at present the outlook seems good.

You will note that in these histories I have said very little about the care of the infant, merely detailing the various clinical points of interest. It has seemed to me that in the treatment of diseases of infancy far too much stress has been laid upon the medical treatment and far too little upon the nursing facilities. In my experience the results obtained in infant feeding in general have, to a large extent, been successful or unsuccessful depending upon the character of the care which the child obtained. This is especially true of the premature infant. It should be emphasized that too much care is much worse for these children than too little, but it also should be emphasized that intelligent scientific nursing with good judgment on the part of the nurse is absolutely necessary in the care of the premature infant.

The babies included in this small series were all in electrically heated incubators. These incubators, as you all doubtless know, are subject at times to changes of temperature which have a most decided effect upon the temperature of the infant. It has long been regarded as a cardinal principle in the care of the premature infant that the temperature of the body must be conserved under any and all circumstances, and that if the temperature of the incubator drops a few degrees, the drop in the temperature of the infant's body may be such as to imperil life. I have not, however, seen much mention made of the danger of a sudden rise in temperature of the incubator, and yet in this series of cases this fact was very noticeable, the temperature rising sometimes as high as 103° or 104° due to a sudden rise in the temperature of the incubator. Certainly such a rise in temperature in premature infants is not to be totally disregarded, and a careful observation of the temperature within the incubator at frequent intervals is also for this reason necessary if one wishes to get the best results.

We were peculiarly fortunate in this series of cases to have no case where the temperature was below 94°F. As Budin has so beautifully shown, the mortality in premature infants depends to a very great degree upon the temperature of the infant before admittance. Of one hundred and three infants weighing 3 pounds or less, whose temperature at the time of entrance was 90° or under, only two lived; of seventy-two whose temperature was between 90° and 92.3°, two lived; of thirty-




nine weighing between 3 and 4½ pounds, whose temperature was under 90°, one lived; while of eighty-three whose temperature was between 90° and 92.3°, twelve lived. Of those weighing over 4½ pounds with a temperature of 90° or under, six died and two lived; while of those with a temperature between 90° and 92.3°, nine died and four lived. It will be seen from this that of the factors which influence life in premature babies, not only temperature, but also weight, is of prime importance.

In regard to weight we were certainly not so fortunate in these cases as we were in regard to temperature. Of these eight babies one weighed less than 2 pounds; three weighed between 2 and 3 pounds; three weighed between 3 and 4 pounds, and one weighed 6 pounds when first seen. At least two of these babies weighed less than a kilo.

The following routine was carried out in the care of the babies. Each infant was given an oil bath every day. This was carried out as quickly as possible in a very warm room and the child immediately returned to the incubator. In extremely small infants the covering consisted of a layer of cotton held in place with gauze; those some heavier had a slip and a small diaper. The only times when these babies were disturbed was at the time of feeding and when given water; then if necessary they were changed and the food (and water) was administered. Water was given in small quantities midway between feedings. At first we tried feeding with a medicine dropper but this proved to be a very time-robbing process and one which seemed to induce vomiting. It was, therefore, very soon abandoned and in the earlier stages the children were all fed by gavage, feeding being carried on in the incubator with, of course, doors open. The amount of food was determined by the size of the child, varying from ½ to 1½ to 2 ounces. The point which I most wish to emphasize is the fact that no one of these babies was fed oftener than every four hours. Next to the careful attention which these infants received, it has seemed to me that the four-hour interval was largely responsible for our success. The infants all ceased regurgitating within a very few days after birth and apparently took good care of the food given. By means of the four-hour interval we were able, first, to a large extent, to prevent over-feeding. Second, to reduce the tendency to vomiting which in my experience has been a rather serious complication in these cases. Third, to avoid frequent disturbances of the infant and hence to avoid subjecting it to frequent changes of temperature. Attacks of cyanosis, which are accounted for by most writers on the score of both underfeeding and overfeeding, were relatively rare in this series, and I feel that this is strongly confirmatory of the results obtained by Litzenberg with the four-hour interval.

You will probably remember that two of these cases were fed artificially; that in these cases undiluted albumin milk was used and you may be surprised that one should recommend such concentrated nourishment for a premature baby. If we consult the various statistics which have been compiled upon the metabolism of the new-born infant, we find that with one exception all investigators have reported a negative nitrogen balance. The exception in this case, however, is so well taken and so ably defended that it seems to me that we must discard other conclusions and agree with Birk. Birk was the first to realize that the physiological food for a new-born infant was not breast milk but colostrum, a food which is rich in protein and poor in sugar and fat. He showed that when new-

born infants were fed colostrum the nitrogen balance was well maintained. Arguing on this basis, I felt justified in using a food which contained as large a percentage of protein as does albumin milk, and I feel the two cases reported support such a theoretical basis.

In conclusion I wish to say, first, that this series is manifestly too small to permit of more than tentative statements in regard to the premature infant. The one fatal case was in an infant born under conditions which almost preclude the possibility of any extended period of existence. So far as I know, no infant born under the same conditions has ever lived for more than a few days. It is very apparent that we have been fortunate in that the infants have not been tainted with any congenital disease, such as syphilis, which would render the task more difficult.

The three things which I would wish to emphasize in regard to these cases are:

First, the fact that attention to detail was largely responsible for the survival of seven out of eight premature babies.

Second, that in every case the four-hour interval was strictly observed.

Third, that in the two cases which were fed artificially, undiluted albumin milk was given to which, within a few days, was added carbohydrate in the form of a dextrin maltose mixture.

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# AN UNUSUAL CASE OF GENITO-URINARY TUBERCULOSIS

BY ROSS ANDERSON, M.D., SALT LAKE CITY, UTAH

MRS. C. J. L., age 34; housewife, married. Family history negative. Past history negative.

*History of present trouble.* In March, 1913, the patient began to complain of backache and pain in right side. Two months later she gave birth to a healthy child. Since the birth of the child the patient has complained of slight fever, loss of appetite, weakness, night sweats, backache, and pain in the right side. She had frequent desire to urinate and was very nervous. Menstruation began six months after child was born; it was regular but profuse, and lasted seven days.

*Physical examination.* General appearance, run down; mucous membranes, pale; tongue furred. Temperature 99⅘° F. in morning, and 103° F. in the evening; pulse 96 to 110 regular. Heart and lungs were in good condition. There was a tumor mass involving right tube and ovary.

*Diagnosis.* Infection in right tube and ovary, probably tubercular. I advised operation, but the patient refused, so I gave general tonic treatment.

September 2, 1914, or eighteen months after the beginning of the first symptoms, I was called again. At this time the patient complained of severe pain in right side of body, which was worse in the shoulder and radiated down the right arm. She had headache. Examination showed that the tumor had grown larger, extended higher, and seemed adherent to back.

Operation September 4, 1914. Growth is seen to involve uterus, right tube and ovary, right ureter, and kidney. Kidney shows hydronephrosis. I removed appendix, which was adherent to mass, uterus, right tube and ovary, ureter, and kidney. The growth involving the ureter was firmly adherent to the iliac artery and vein. In freeing the growth from the common iliac vein, the vein tore as would wet pasteboard, and this necessitated ligation in two places, above and below the point of rupture. In closing the abdomen there was a marked venous oozing, which showed how readily the collateral circulation was established.

The patient made an uneventful recovery and left the hospital on the twelfth day following the operation. The pathologist reports that the tumor was not a new growth, but a degenerative process, but he was unable to give it a definite name. The growth showed a degenerative process identical with that seen in tubercular caseation.

So far as I have been able to search the literature, I have never found a case reported where the common iliac vein was ligated.

I should have stated that the growth involving the uterus and right broad ligament was about as large as a good sized orange and that the ureter was about one and one-quarter inches in diameter and had the appearance of a sausage. The cause of the hydronephrosis was the involvement of the ureter with the tuberculous growth.

## URINARY INCONTINENCE IN WOMEN

By R. CADWALLADER, M.D., San Francisco
Professor of Obstetrics and Associate Professor of Abdominal Surgery, College of Physicians and Surgeons

THE following case will undoubtedly be of interest.

Mrs. J., widow, aged 32, born in Denmark, domestic by occupation, entered the City and County Hospital and was treated for periostitis by the general surgeon. Six years ago, following some months of bladder trouble, she passed a stone and later was operated upon for a larger stone by lithotrity. Since then she has had a complete incontinence of urine. She was referred to me for relief from a condition rendering her life unendurable.

When I began to plan what to do I could find nothing but the old Gersuny operation dating back to the late 80's. I went over the *Index Medicus* from January, 1900, to January, 1914, without a hint. Then I began to work out a procedure of my own. Without going into the anatomy too closely, if there was musculofibrous tissue on either side of the urethra to fasten the fundus to, as is required in the Wertheim-Watkins operation, this ought to be available to bring around behind the urethra and form a new sphincter; and possibly, too, the old sphincter might be repaired much as a lacerated perineum is repaired. I felt certain that a twisting or infolding would not give permanent relief.

On September 30th I split the vaginal wall back for four cm. from the meatus and lifted it free from the bladder. The posterior half of the meatus was encircled and the redundant membrane cut away. A fine full curved needle of iodized No. 1 catgut was passed well ahead of the urethra on one side and in the same way on the other. Four of these were passed and, when tied, mattressed the tissues behind the urethra. The membrane was then closed by a continuous stitch. When completed the urethra would just pass a No. 16 French sound; before operation anything up to one-half inch passed.

I then tested the bladder with saline solution and found it held about three ounces and this would not leak by pressure on the trigone. A catheter was left in the bladder for forty-eight hours.

The result was all that could be hoped for. She was discharged in two weeks with a capacity of nearly three ounces and could retain urine perfectly for two hours. There was no leakage for this length of time or until the bladder contained three ounces, and I think it safe to predict that as the bladder enlarges the capacity will be increased.

Before reporting upon this case I again looked up the literature and to my surprise and disappointment found that I was not the originator of a new operation for Howard Kelly[1] had reported a list of twenty operations identical in every particular except that he used silk and I had used iodized catgut. Had I looked over the literature of this year I would have found what I had hunted for. It may be that some extract of his article fell under my eyes and that I unconsciously followed it, but at the time I honestly thought I had devised a new procedure. All I can claim now is to report the twenty-first case and the seventeenth cure.

[1] Surg., Gynec. & Obst., 1914, xviii, 444.

## TREATMENT OF PURULENT STREPTOCOCCIC CEREBROSPINAL MENINGITIS

By W. SOHIER BRYANT, M.D., A.M., F.A.C.S., New York

THE treatment of purulent streptococcic cerebrospinal meningitis is perhaps the most difficult and important clinical problem of surgery. The object of this paper is to apply the experience of an unusually successful case to the management of this infection.

The otolaryngological problem of the treatment of this variety of meningitis is analogous to the problem of the treatment of streptococcic puerperal sepsis in obstetrical practice. It seems to me that the otologist and the laryngologist may receive much help from their colleagues in the field of obstetrics. The seat of the infection in septic cerebrospinal meningitis,

like that in puerperal toxæmia and bacteriæmia, is beyond the reach of incisive surgery, because in both these diseases, the organs are either too vital or too delicate to endure excision or even an adequately free exposure for drainage. Therefore, treatment of meningitis should be developed chiefly along the line of control of the toxæmia and bacteriæmia. This mode of management of an analogous condition has also been used by the obstetrician in his fight against puerperal streptococcic septicæmia, that most destructive and dangerous obstetrical complication. In meningitis, as in puerperal sepsis, the most dangerous infections come through streptococci.

My attention was first called to the biological importance of magnesium sulphate through learning that it was capable of maturing unfertilized eggs of the sea urchin. It occurred to me that the stimulating effects of this magnesium salt might be turned to good account in surgical sepsis. For nearly ten years, I have used this salt of magnesium in meningitis and the other toxic conditions of otolaryngology, from the mildest to the most severe, with great benefit.

The obstetrician, in his most difficult problems of puerperal sepsis, has used this salt intravenously with brilliant success. Since meningitis and puerperal sepsis are analogous in the respect that they are both impossible of surgical removal and are both due to the same bacterial infection, it seems reasonable that the general treatment that benefits one will benefit the other.

My plan has been to give by mouth in repeated small doses as much of the well-diluted magnesium sulphate as the patient can tolerate without too great looseness of the bowel. The intravenous injection of magnesium sulphate, the method used by the obstetrician, in emergency, is more efficient than the administration of the salt by mouth; but under ordinary conditions, I have found the administration by mouth very convenient and effective.

### TREATMENT

Treatment of purulent septic meningitis consists of (1) treatment for relief of the intracranial pressure, (2) treatment of the toxæmia, and (3) treatment of the focal infection. The goal of the treatment is the control of intracranial pressure and toxæmia, and the treatment should, therefore, be symptomatically directed against these two means of fatal terminations of the disease.

Cerebrospinal meningitis, owing to the topography of the meninges, the vital importance of the structures they cover, and the friability of these structures, offers no final surgical solution, since excision and free drainage are impossible. The methods for the relief of intracranial pressure are few and simple and very effective. The various complicated methods that have been devised incur many fatalities and are no more effective than the simplest method. The type of surgical interference indicated depends upon the duration and gravity of the symptoms. In the grave and acute conditions, the indication is, first, for decompression; second, for drainage; and third, for removal of the primary focus. The best results seem to follow decompression by removal of enough of the calaverium to expose the dura mater for an area of an inch to an inch and a half as near as possible to the point of entry of the infection. If still more relief of pressure is needed, the area of exposed dura mater may be increased and the dura mater may be incised. (Day [3] reports recovery in a case of streptococcic cerebrospinal meningitis, after treatment by dural drainage.) In mild subacute cases, lumbar puncture may furnish sufficient decompression.

Local cranial drainage is provided by incision of the dura mater. This type of drainage is preferred to lumbar-puncture drainage because it drains directly from the focus of infection. In mild subacute cases in which the decompression operation may not appear to be urgent, repeated lumbar puncture may provide sufficient drainage. Lumbar puncture is contra-indicated in cases of definite intracranial pressure, lest it should assist in the dissemination of meningeal infection.

The seat of primary infection should be dealt with by appropriate surgical management. Local antiseptics, such as tincture of iodine, alcohol, bichloride of mercury, aluminum and lead acetate, 1 per cent *fuxin für bacterien*, boric acid, chinosol, phenol, *eau de Javel* and many others, are efficacious when indicated.

*Toxæmia.* The following are the various methods of controlling toxæmia and meningitis: (1) the administration of magnesium sulphate as an antiseptic alterative; (2) the flushing of the blood-stream; (3) immunization; (4) administration of hæmatic and local antiseptics such as silver and mercurial salts and urotropin; and (5) stimulating general hygiene. Of these methods, I have found that the administration of magnesium sulphate as an antiseptic alterative is by far the most efficacious. The salt should be well diluted and given by the mouth in as large quantities as the intestines will endure without having the purging too exhausting.

A research of the literature on the subject shows that in 1908 Meltzer (4) proved that a weak solution of magnesium sulphate could be injected into a vein without danger, provided that it was injected slowly. Huggins (2) was the first to use magnesium sulphate intravenously for puerperal sepsis because he had found it useful as a local application in erysipelas. This was in 1910. He reported four cases of puerperal sepsis cured by the very slow injection of 30 grains of magnesium sulphate in 8 ounces of normal saline solution. The same year, Lobenstine (5) reported that, out of five cases of puerperal sepsis, four patients recovered. Three of these cases were cases of fulminating streptococcic toxæmia; the other was of streptococcic bacteriæmia. Treatment was intravenous injection of magnesium sulphate. Harrar (1), who says that magnesium sulphate is curative only in the acute stage of infection, reports nine cases of severe puerperal infection; five with bacteriæmia. Intravenous injection of magnesium sulphate resulted in recovery in eight cases. The maximum dose was 400 ccm. of a 2 per cent solution of magnesium sulphate in freshly distilled water intravenously, and 400 ccm. by hypodermoclysis equal to 16 grains or 250 grains of the salt per day. The intravenous injection should, according to this author, take twenty minutes and should, if required, be repeated on the second or third day. In the Lying-In Hospital of the City of New York, the rate of mortality in puerperal streptococcæmia, the form of puerperal infection most liable to be fatal, has, by this treatment, been reduced from 93 per cent to 20 per cent.

The blood-stream is flushed in either states with the hope of washing out some toxins. This is accomplished by intravenous injections of saline solution, transfusion of blood, epidermiclysis, proctoclysis, and fluids by the mouth, all aided by venesection.

Immunizing treatment has been reported by some writers to be helpful in the treatment of purulent streptococcic cerebrospinal meningitis. My experience with this type of treatment has not yielded encouraging results. Day (3) reports a case of purulent streptococcic cerebrospinal meningitis cured by the use of antistreptococcic serum and autogenous streptococcic vaccine.

The use of urotropin by the mouth, hypodermatically or intravenously, in septic cerebrospinal meningitis, does not appear to the author to be an efficient method of treatment, nor does the intrarhacidian injection of urotropin appear to be much more efficacious, because the subsequent action of the urotropin is very much in doubt. The liberation of formaldehyde may not be in sufficient quantity to sterilize the cerebrospinal meninges. It seems to me that a very definite action on the infection may be obtained by a direct antiseptic applied in the blood-stream or the cerebrospinal sac. Such an antiseptic is, for example, a colloidal salt of silver, or a mercurial salt.

To help the patient throw off the toxins and overcome the invading bacteria, stimulating and general hygiene should be employed. Cures that follow prolonged acute infections may sometimes be attributed to wholesome food, large quantities of water, fresh air, sunlight, and complete rest, quite as much as to any other method of treatment.

### PROGNOSIS

In intracranial pressure, nature is working against herself. The inflammatory reaction is needed to control the bacterial invasion. This reaction produces the intracranial increased pressure which, when extreme, causes death. It is a nice question of balance between death from the bacteria and death from intracranial pressure. The repeated microscopic and bacterial study of the cerebrospinal fluid is of great prognostic value, since it shows favorable or unfavorable bacterial changes.

The course of the streptococcic cerebrospinal meningitis of the fulminating variety is death in a few days, usually from intracerebral hypertension. In the less violent cases, death may supervene from toxæmia at a slightly later date. It does not appear either from my own experience or from research of the literature that streptococcic cerebrospinal meningitis has ever recovered spontaneously. The number of cases recorded where life has been prolonged beyond the acute stage of the meningitis have been so few that up to this time it may be called a disease with 100 per cent mortality. In the recent literature we have found only one case of cure, a case of streptococcic cerebrospinal meningitis. This case is reported by Day (3).

I offer the following case showing recovery from purulent streptococcic cerebrospinal meningitis.

The patient was a man 23 years old. The symptoms were rapidly increasing coma, neuromuscular signs of meningitis, rigidity of neck, choked discs and purulent otitis media and mastoiditis. Temperature 102½°, pulse 40. Spinal fluid contained cocci in pairs and short chains and pus. Decompression at once removed the mental symptoms. Mastoid operation. Epidermiclysis, enemata, saline solution by the mouth and solution of magnesium sulphate by the mouth. On the seventh day

following decompression, all sign of meningitis had disappeared. Patient died 188 days after the decompression operation from toxæmia caused by the repeated secondary infection of the decompression wound.

CONCLUSION

The combination of our experience as otologists with the experience of the obstetrician makes the outlook for successful treatment of streptococcic cerebrospinal meningitis appear much brighter than it has previously appeared. Otolaryngologists should get as good results in cerebrospinal meningitis as the obstetrician obtains with puerperal sepsis cases. Although the surgeon can readily protect the patient from death by intracranial pressure, the management of the sepsis is quite another problem. This problem of sepsis has received more attention from the obstetrician than from any other medical group or specialty. The treatment should be focused on decompression, local and systemic drainage, administration of magnesium sulphate, and stimulating general hygiene.

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# HOW TO SHARPEN A SCALPEL

BY V. BERRY, M.D., OKMULGEE, OKLAHOMA

SOME time since an itinerant vendor entered my office from whom I purchase a paste called "Onyxite," which when spread on a leather strop proved very effective in producing a keen edge on scalpels. I paid five dollars for three small boxes of the paste. In a short time I began to wonder what I should do when the supply ran out, so had a small quantity of the paste washed out in ether and the powdery residue placed under the microscope. We found the residue similar if not identical with size No. 1 F carborundum powder, which costs about forty cents per pound. One pound will make enough paste to equal about fifty dollars worth at the price I paid for the three boxes. The paste is made as follows:

A quantity of clean beef fat is rendered to common tallow, strained through fine cloth or canton flannel, and while in the melted state, carborundum powder No. 1 F is stirred into the melted tallow to make a stiff paste. The mixture is then allowed to cool.

To use the paste, simply spread freely on a smooth strop, lay the strop on a table, and draw the scalpel back and forth at *right angles*, not diagonally. This absolutely solves the problem of a keen-edged knife. In cold weather if the paste is too stiff, add a drop or two of olive oil to the paste on the strop. If you wish an extremely smooth and keen edge to finish the sharpening a paste can be used of No. 2 F carborundum powder mixed in tallow. However, the No. 1 gives an edge as sharp as a razor, and a dull instrument can be sharpened in one-fourth the time that a stone will do it, and the result is by far more satisfactory.

# TRANSACTIONS OF SOCIETIES

## CHICAGO GYNECOLOGICAL SOCIETY

REGULAR MEETING HELD NOVEMBER 20, 1914, WITH THE PRESIDENT, DR. ROBERT T. GILLMORE, IN THE CHAIR

DR. CHARLES S. BACON reported a case of "Extramembranous Development of the Fœtus."

Within the last twenty or thirty years the possibility of continued life and development of the fœtus after its escape from the amniotic sac in consequence of a premature rupture of the membranes has been recognized and about fifty cases have been reported. This accident occurs generally between the twelfth and eighteenth weeks of gestation. The membranes contract to some extent around the cord, and when labor occurs some weeks or months later the sac is obviously too small to hold the fœtus. There is more or less continuous discharge of liquor amnii causing the hydrorrhœa uteri amnialis. This fluid often contains considerable blood, at first from the torn vessels of the ruptured membranes and later from the endometrium injured by the fœtal movements.

There are probably different causes for the rupture of the membranes. Sometimes it may be due to trauma, perhaps in an attempt at criminal abortion. Deciduitis has been blamed. In most of the cases reported there has been found a placenta marginalis or circumvallata. Attempts have been made to make this abnormality the chief factor in the rupture of the membranes. That pregnancy should continue after the expulsion of the fœtus from the sac is perhaps no more strange than are the cases, not so very uncommon, of missed abortion.

Patient, Mrs. G., age 27, had one pregnancy with normal labor at term, May 9, 1913. During the last month of pregnancy she had some toxic symptoms which were combated with rest in bed, diet, and elimination.

She menstruated about November 1, 1913, and missed the December menstruation. In January, 1914, she had a bloody discharge for a few days which she considered a menstrual flow. In February she had a free flow for over two weeks which gradually stopped. At first it was bloody, but later watery. During the month of March there was considerable watery discharge from the vagina, sometimes tinged with blood.

On the 29th of March, while at stool, without recognizable uterine pains, there was a sudden prolapse of the cord from the vulva with little or no water. She went to the hospital where I saw her a few hours later. Coils of the cord were in the vagina and the cervix was dilated to admit the passage of only the two portions of the cord. As the uterus showed little tendency to expel its contents and the prolapsed cord furnished an open route for the contamination of its interior, the patient was anæsthetized about four hours after the first examination, the cervix dilated somewhat, and the fœtus and after-birth extracted. In the extraction of the fœtus, which presented by the feet, the pelvis was separated from the trunk and the head was torn off and had to be removed with a large artery forceps. The after-birth was removed in one piece without much mutilation.

The fœtus was about 19 cm. long and corresponded in development to the supposed duration of gestation; i.e. about 19 weeks. It showed no marked deformity. The placenta was about 10 cm. in diameter. The opening into the fruit-sac was at the border of the placenta on one side. The free border of the membranes was smooth and looked like the organized edge of a ring and not like a fresh tear. The diameter of the ring was about 3½ cm., while the diameter of the sac was perhaps 5 cm. The sac was hardly large enough to hold the head of the fœtus. The membranes showed an obscure fold at the attachment to the placenta which might suggest the beginning of a marginal fold; i.e., a placenta marginata.

In this case there was a bloody discharge in the ninth week of pregnancy which did not end in an abortion and which might have been due to the low implantation of the egg. About the thirteenth week there was a rupture of the membranes and escape of the fœtus from the amnial sac. This was accompanied with a bloody watery discharge which continued for two weeks when it nearly stopped for a few days. From the sixteenth to the end of the nineteenth week when pregnancy terminated there was a continuous watery discharge, sometimes tinged with blood.

The case corresponds with other cases of hydrorrhœa uteri amnialis with extramembranous development of the fœtus in all essential features. The amniotic sac was too small to contain the fœtus. There was the hydrorrhœa which was at times bloody. At the time of labor there was apparently no rupture of membranes and escape of liquor amnii.

DISCUSSION

DR. W. A. NEWMAN DORLAND: How long had pregnancy existed?

DR. BACON: About nineteen weeks.

DR. DORLAND: How long had the fœtus been dead?

DR. BACON: The fœtus was probably alive before prolapse of the cord. Apparently it had only just died.

DR. CHARLES E. PADDOCK: I cannot see any discrepancy in the size of the placenta and fœtus. One corresponds with the other. It is possible the sac may have contained the fœtus; that the fœtus may not have escaped at the time mentioned. I would like to know whether Dr. Bacon is sure that it was liquor amnii that escaped.

DR. BACON: The fluid was not examined, but from the patient's description of the character and quantity of fluid I have no doubt it was liquor amnii. The possibility of hydrorrhœa amnialis has been disputed, especially by the Germans, for many years. Until recently cases of hydrorrhœa were supposed to be of decidual origin, but lately so many cases have been reported that everyone now acknowledges that there is such a thing as a hydrorrhœa amnialis. There are two varieties: one where the fœtus remains in the sac, and the other where it escapes.

The possibility of making a diagnosis during the pregnancy depends upon the determination of the character of the contents of the fruit sac. I do not know what the nature of the discharge was in this case, although it was very watery. The placenta corresponded to the size of the fœtus, but the sac itself was much smaller and was scarcely large enough to hold the head of the fœtus. There was no membrane lost; the entire placenta was there; it came away in one piece after extracting the child. One can easily see, I believe, that the sac could not hold the child.

DR. J. CLARENCE WEBSTER read a paper entitled, "A Series of Cæsarean Sections Performed under Local Anæsthesia." (See p. 221.)

DISCUSSION

DR. DORLAND: Were any of these operations Porro operations?

DR. WEBSTER: No. I have performed hysterectomies for fibroid tumors under local anæsthesia and have always infiltrated the broad ligaments. I have carried out a variety of operations under local anæsthesia in the abdomen for conditions other than pregnancy, but only twice in cases of excitable and not easily controlled Italian women, was it necessary to abandon the procedure and to use a general anæsthetic.

One of my most interesting abdominal operations under local analgesia was in a case of abortion complicated with a strangulated inguinal hernia. The patient was exsanguinated as a result of the abortion. I removed the remains of the abortion, packed the uterus, made an inguinal incision, resected about twelve inches of the intestine, and repaired the hernia, entirely under local anæsthesia, and the patient made a good recovery. Murphy's button was used in closing the bowel.

DR. CHARLES E. PADDOCK: My experience with the use of local anæsthesia in the cæsarean operation is limited to one case. This case was one where the patient was suffering from a mitral stenosis and in labor at term. A one-half per cent novocaine solution was used with perfect success, and apparently there was no discomfort until the child was removed. From this time, owing to unnecessary traction on the broad ligament, there was considerable pain. This pain, I believe, can be overcome if the idea be abandoned that manipulation and traction of the uterus are necessary to control hæmorrhage. It is not necessary to compress the broad ligaments or the uterus. Bearing this in mind, the entire operation can be conducted without pain to the patient. In the case mentioned, novocaine was not injected into the uterus and the uterus was opened *in situ*.

DR. RUDOLPH W. HOLMES: Some years ago I had two cases of œdema of the cervix, both of which were in the last days of pregnancy. One had at that time a tumor similar to the one described by Dr. Webster. The cervix was not ulcerated, but still a mass, half the size of a fœtal head, projected beyond the vulva. By keeping the patient recumbent, with the hips elevated, and by applying hot fomentations, the œdema rapidly disappeared so that at the time of labor the cervix offered no obstruction to labor, and there was no anomalous dilatation. In this patient there was marked œdema of the legs, due to pressure. In the other patient the cervix was very large, completely filling the vagina, and, while visible from the introitus, did not extend beyond it.

With reference to local anæsthesia, I have not used it in either cæsarean section or other abdominal work. I have seen a number of nerve-blocking cases in abdominal work and in each one there were, at least, disagreeable lamentations on the part of the patient; the patients in two or three instances moaned and squirmed so vigorously that general anæsthesia was required to complete the operations. I have yet to be convinced that for the usual run of patients the risk

of a well administered general anæsthetic is any greater than mental shock incident to this local anæsthesia.

DR. ROBERT T. GILLMORE: I have tried nerve-blocking in three or four cases, and found that it was not very satisfactory. In two of the cases I had to resort to general anæsthesia after the abdomen was opened. However, after the favorable experience of Dr. Webster I would not hesitate to try local anæsthesia again.

DR. N. SPROAT HEANEY: My experience is limited to one case under local anæsthesia. I did not have quite as good success as Dr. Webster has had with his cases, as I found it necessary to give the patient ether to close up the parietes.

I have been much impressed by the complete absence of apnœa in the cases delivered by Dr. Webster. It is a comforting experience to have the baby cry immediately with cæsarean section, because one should give strict attention to the mother, and not have to spend time in attempts to revive fœtus. The children without exception cry immediately in all the cases I have seen.

DR. WEBSTER (in closing): Dr. Paddock was correct in saying it was not necessary to grasp the broad ligaments, the cervix, and lower uterine segment to control bleeding, but I do not think it is right to leave the statement in that form. If one did not operate in labor, but selected a time before labor had started, pituitrin should be given before the operation. After opening the abdomen one should wait a short time until hardening of the uterus occurred, because if the latter is incised at this period, there is likely to be a very slight loss of blood, and retraction is likely to follow immediately after the contents of the uterus are removed. In this condition constriction of the ligaments and lower uterine segment is not necessary. If, however, there is no hardening of the uterus, blood may escape freely from the divided vessels, especially if the placental area be divided. If excessive, it may be necessary for the assistant to exercise control by manual pressure, as above mentioned.

I have done nearly one hundred abdominal cæsarean sections and have never lost a mother. I have lost only one full-term child, the death occurring two or three days after delivery, due to a defective cardiac condition. Curiously enough, this was a case in which the operation had been done under local anæsthesia, and no deleterious influence was traceable to chloroform or ether.

DR. WEBSTER also reported a case of "Protrusion of the Cervix Beyond the Vulva in a Full-Term Pregnant Woman." He stated that he had not seen a similar case in twenty-five years.

The patient was a negro woman recently admitted to the Presbyterian Hospital in labor. There was a projection of the cervix beyond the vulva, about three inches in diameter. The cervix was markedly œdematous and congested, with an extensive erosion, being considerably strangulated by the pressure of the tissues around the introitus vulvæ. The fœtal head was above the brim and could be felt distinctly. The lower uterine segment was much stretched vertically. The cervix dirty from rubbing against the patient's clothes was so dilated that one could introduce the thumb easily. It was cleansed externally and internally with iodine and pushed upward into the vagina, which was also cleansed. Abdominal cæsarean section was carried out, the mother and child recovering.

Such cases are very rare. It is rather remarkable that there should have been constriction of the cervix by the vulva in a woman who had given birth to three children. The introitus was small. The patient stated that she had had uterine prolapse after her first labor, but there had been no trouble in her confinements. The protrusion of the cervix from the vulva in this instance had been noticed during the past three weeks, having gradually increased in size. The urinary symptoms were practically no more than the ordinary woman experiences in a full-term pregnancy, though there was marked pulling down and pressure of the bladder against the symphysis. The lower uterine segment was greatly stretched and attenuated, and was therefore liable to rupture if labor was allowed to take place. Moreover, the cervix was œdematous and, easily torn. Abdominal cæsarian section was considered the safest method of delivery.

DR. RUDOLPH W. HOLMES exhibited a specimen of "Bilateral Dermoid Cyst" which had been removed from a woman 27 years of age and who had been married ten or eleven months.

In March, when married about three months, she had a miscarriage; she stated the doctor had great difficulty in removing the products of conception. Shortly before her marriage her appendix was removed, and she was told that a palpation of her normal left adnexa was made. The woman stated that since a fall down stairs three years ago she has had pain in the right inguinal region in the intervals of menstruation, and that as soon as the flow is established this is markedly ameliorated. Since her miscarriage the inguinal pain and a backache have so increased that she had to have relief. A couple of weeks previously she had visited a physician who declared she had an adherent retroverted uterus and had advised an operation for the rectification of this condition.

On examination I found a mass filling the true pelvis, which pushed the uterus strongly to the left. On the left, and high up, was a second tumor the size of an egg. On operation there was some considerable difficulty getting the large tumor up out of the pelvis, although there were no adhesions, on account of the strong atmospheric pressure on the tumor. The large tumor presented the not uncommon appearance of a multilocular ovarian cyst. Tube and tumor were removed. As the left ovarian tumor presented a small area of apparent normal ovarian structure an attempt was made to resect this. The wall was so thin that the semifluid contents of the tumor squirted out, and a couple of drops fell onto the abdominal incision; on this account the left ovary was completely removed. On the third and fourth days the woman ran a temperature; the fifth day the wound was red, and predicted a wound infection. The next day an ounce of very fetid pus escaped, a colon bacillus infection being present.

Dermoid tumors are not rare, but bilateral ones are more infrequent. That one of the tumors should have been a multilocular dermoid is unusual in my experience.

DR. WEBSTER: In one case of bilateral dermoid, where one ovary was removed and the other resected, I was able to conserve a small piece of ovary not larger than a bean, and the woman has since borne two children.

DR. EMIL RIES: I understand Dr. Holmes to say that there was infection of the abdominal wall, with the escape of dermoid contents.

DR. HOLMES: I have not so stated but I believe that the fluid pus which escaped from the ventral incision was due to a colon bacillus infection, which was caused by the dermoid contents touching the incision when the left cyst opened.

DR. RIES: Was the dermoid infected or suppurating?

DR. HOLMES: The left cyst was soft. From the sequence of events it would seem that it was already infected, at least, this is the way I interpreted the infection of the wound.

DR. RIES: From what we know of rupture of dermoid cysts spontaneously or accidentally without operation, we could not assume that the contents of the cyst lead to suppurative traction of the tissues. One of the earliest cases of dermoid cyst on which I operated was in a young girl who had had such a rupture of a dermoid previous to the operation. There were particles of the dermoid, grumous stuff, and hair surrounded by omentum, encapsulated by omentum, without any further disturbance in the abdomen. In making an attempt to conserve a piece of ovary, it happened occasionally that while cutting the dermoid away from the ovary, one would cut into the lumen of the dermoid and there would be escape of a little dermoid tissue. I have done this in two cases and in neither one of them did suppuration follow. The material of a dermoid could not be considered other than bland. It is nothing but epithelial cells, a little hair, etc., and why that should lead to inflammatory reaction is not readily seen.

DR. E. W. FISCHMANN: During the early part of this year I operated on a woman, twenty-two years of age, for a chronic appendix through a McBurney incision. There were a great many adhesions present. After finishing the operation I explored the genital organs and found the ovary on the right side a little larger than the average English walnut. I judged the ovary to be cystic. The lower part seemed to be in good condition, and I decided to resect a portion of the organ. While resecting, a little of the contents of the cysts escaped. I paid very little attention to this, sewed up the ovary, and after removing and examining the specimen found it was an ovarian cyst about the size of a small filbert. I am certain that this oily droplet from the dermoid had come in contact with the visceral peritoneum, but the patient made an uneventful recovery without any suppuration.

DR. JONES: I have not had experience with soiling the abdominal cavity with the contents of dermoid cysts, with infection following. Two years ago I looked up the literature of ovarian cysts complicating pregnancy, and remember distinctly several writers spoke particularly of the danger of dermoids complicating pregnancy and of care in handling them with a view to excising the dermoid intact. If the dermoid is punctured, precaution should be taken that the cyst be removed within twenty-four hours after the delivery. Dermoids are dangerous in that they might lead to infection.

DR. N. SPROAT HEANEY: This recalls a case I saw when I was with Dr. Webster. The patient was operated upon for extensive tuberculosis of the peritoneum. The uterus, tubes, and ovaries were of normal size and appearance. A year and a half later she was operated upon for large bilateral dermoid cyst of the ovary.

Dr. Holmes attributed the infection in his case to the presence of the caseous material from the dermoid. I believe this supposition is well founded. While perhaps not infective itself, the contents act as a foreign body.

DR. WILLIAM M. THOMPSON: I would call your attention to a case of dermoid cyst complicating pregnancy which I reported to the Society eight years ago.

A large tumor presented behind the cervix. The woman had been in labor some twenty-four hours and a physician had applied forceps. The tumor presented itself more and more prominently, with dystocia. The cyst was almost as large as the full-term uterus. It was the largest dermoid I have ever seen. The woman was delivered in a kitchen in the slums, and she recovered. A vaginal section, making an incision behind the uterus was done. The dermoid was delivered, incised, and the contents drained, the sac was drawn out, the stump ligated, and the fœtus, which soon died, delivered.

At the time I collected all the literature available on the subject of infections due to dermoids, and while I had always understood that the material was infectious, I was unable to verify this statement from the literature. While my case recovered, the patient had an infection afterwards, due undoubtedly to the manipulations practised for twelve hours before I saw her.

DR. HOLMES (in closing): It has been taught from my earliest medical training that dermoids, of all ovarian tumors, are most likely to become contaminated by contiguity. Oftentimes the infection is latent, and then under the influence of labor, or some traumatism, the infection actively lights up. From the very nature of dermoids, the desquamated epithelial cells, the sebaceous matter, would make an excellent culture medium. Having that fixed idea, I naturally presumed from the fact that dermoid matter had lodged on the wound that the infection was due to this source. I did not believe the infection was an extension of a process originating in the pelvis.

DR. C. G. GRULEE read (by invitation) a paper entitled "Care and Feeding of Incubator Babies." (See p. 234.)

DISCUSSION

DR. JULIUS H. HESS: I regret that Dr. Grulee gave so much credit for his success in treating premature infants to the four-hour period of feeding and so little to his adequate care in the nursery, because as yet there were only a few statistics published on the four-hour feeding period of this class of infants. Those of Litzenburger and Dr. Grulee's were the only ones of which I have personal knowledge, in this country, some having been published from European clinics. A great deal of success has been attained before this time by shorter interval feedings, and whether the four-hour period has a distinct advantage over the shorter interval between feedings, I am not prepared to say. Personally, I still continue to feed premature infants at two- and three-hour intervals. My first group of cases consisted of seventeen cases which are the basis of a few figures which I present. In comparing Litzenburger's figures with my own I find that my seventeen babies gained more rapidly than the series of Litzenburger, which consisted of fifteen cases. Each baby must be considered as an individual entity. However, certain general rules as to feeding must be followed.

First, the infants were not fed milk until they had their first bowel movement. If necessary they were given five or eight minims of castor oil. After the first bowel movement feeding consisting of thirty calories of milk to each per kilogram of body weight is started. That would be one and a half ounces of milk to the kilogram of body weight. All of the premature infants were fed on human milk. There was no doubt many of these babies could be raised on artificial food, but beyond any doubt the mortality must be higher. Following the first few days, the feeding was increased by ten calories per kilogram of body weight daily, until ninety calories per kilogram of body weight was reached. After ten or fifteen days it was the aim to work up to somewhere between one hundred ten and one hundred thirty calories per kilogram for those over fifteen hundred grams in weight, and one hundred twenty to one hundred forty calories per kilogram body weight for those under fifteen hundred grams in weight. Huebner's figures for a full-term baby are in the neighborhood of one hundred calories.

In feeding babies one should never lose sight of the individual case, as no two can be fed the same. As to intestinal disturbances, these babies cannot stand starvation and it is wrong to take food from them entirely. The amount of food can be reduced, but all food must not be taken from them on account of intestinal disturbances. Many of these babies have been fed by catheter because of their inability to nurse. It is a mistake to put a baby of this kind to the wet nurse's breast until syphilis has been excluded as this disease is not uncommon among these infants.

(Dr. Hess here exhibited an electrically heated, water jacketed tub for the care of these babies, to be used in place of the incubator). I am indebted to Dr. Lester E. Frankenthal for suggesting the use of a water jacket tub. By the application of an easily regulated electric heating apparatus with a simple rheostat, a constant temperature is maintained, the variable factor in its use being the room temperature.

DR. CHARLES S. BACON: There is one point about the temperature suggested by one of the cases reported by Dr. Grulee, to which I would call attention. The initial temperature of a baby delivered by cæsarean section was found to be 95°. Without special care the temperature falls rapidly in a small baby, but there is no reason why a baby should not be cared for from the beginning so that such a fall in temperature cannot occur. The temperature should be kept at 99°. The importance of temperature has been brought out very clearly by Dr. Hess. Careful attention to details ought to include attention to the temperature of the incubator, which should never be allowed to become so high that it will carry up the temperature of the child after the first three or four days. Sometimes, in very feeble premature children, in the first two or three days of life, the temperature fluctuates remarkably. Whether this is due to the instability of the heat-regulating center of the child or to something else, I do not know. The temperature in these cases ought to be taken every half-

hour or every hour, if there is any question as to the condition of the child.

In regard to feeding these babies, I object to the plan of four-hour feeding, as for practical purposes it is difficult to carry it out. This might be done by Dr. Grulee, but for practical work it cannot be done. Feeding should always be by mother's milk. If the mother cannot furnish the milk, it should be obtained from other mothers in the hospital or in some other hospital. On the West Side a reasonable supply could be obtained from the Cook County Hospital. The feeding of milk by the catheter is decidedly more difficult in the hands of the ordinary nurse than feeding by the dropper, and I believe considerably more dangerous. It is certainly possible to feed a child by the Breck feeder or by the dropper, but it is not possible to give the child any such amounts. It is rather questionable whether these amounts could be given with safety by the catheter. There is more or less regurgitation which is dangerous. It is necessary to feed the child a definite amount. For practical purposes it is difficult to carry out the scientific feeding advocated by Dr. Hess; namely, feeding by calories. It is easier to carry out feeding as Budin advised, who advocated giving definite amounts of mother's milk for the twenty-four hours; namely, from one-sixth to one-fifth of its weight in the case of small babies. If a baby weighing three pounds should take, at the end of a week or ten days, one-sixth of its weight, it must have eight ounces of milk and if it could take only two drams at a time it should be fed more frequently. It is necessary to feed children every hour for the first few days. Later the number of feedings may be reduced to eighteen in twenty-four hours, and gradually as the amount is increased the interval and number of feedings may be decreased until one is able to adopt a three- or possibly four-hour schedule. It is the quantity of food given the child which determines the frequency of feeding, and no hard-and-fast rule can be laid down as to the frequency of the feedings. The average nurse obtains the best results in this way.

Dr. N. Sproat Heaney: What are Dr. Hess's reasons for not feeding a baby until it had its first bowel movement?

I would like also to utter a word of caution in regard to feeding mother's milk. No mother's milk should be used for the nursing of a strange child, no matter how fine her condition is or how healthy her own children appear to be unless she has a negative history, physical examination, and negative Wassermann test.

Dr. Julius H. Hess: These babies should be fed before the mothers have milk in their breasts, which means food from another source. With that milk bacteria enters the intestinal tract. Meconium is composed in great part of protein matter, and it is to avoid decomposition of the protein in the intestine that this point is made, and also to ascertain positively that peristalsis occurs in the proper direction.

Dr. Holmes: Is it not better to wait until meconium had ceased coming?

Dr. Hess: With a mild laxative the period of starvation is greatly shortened, which is of great importance in this class of infants.

Dr. Grulee (in closing): I felt sure that the four-hour feeding interval would receive a few knocks. I wish to call attention to one point that has been overlooked in the feeding of infants. There are two openings in the stomach, one above and the other below, and, within a few seconds after food passes into the stomach it begins to pass out. One would not overload a child's stomach by introducing a certain amount of food into it at one time. I do not see why premature infants should differ from older ones in this respect. Every man who has tried long intervals of infant feeding knows that regurgitation is markedly reduced. It reduces very much the tendency to vomit, because the stomach is not so frequently irritated.

I am not altogether persuaded that a child should not be given food until it has had its first bowel movement.

As to the question of human milk, I wish to answer one point brought out by Dr. Bacon. I have been on the Cook County Hospital staff for three years and find it is very difficult to get breast milk there. In the two cases reported, where the children were fed artificially, there was no chance to get breast milk, and they were fed artificial food because I could not get anything else.

As to temperature, it ought to vary in the incubator with the condition of the child. An effort is made to reduce the temperature in the incubator gradually two or three degrees at a time. In spite of everything the temperature of the incubators does go up at times. The temperature of the infant at birth is higher than the mouth temperature of the mother, but it is reduced rapidly.

One reason why these infants get along so well is that they are fed at four-hour intervals. The chief reason is that they received careful and intelligent attention.

# BOOK REVIEWS

## A CRITIQUE OF NEW BOOKS IN SURGERY

By Major G. Seelig, M.D., St. Louis

WHAT, after all, is more soul-comforting than the consciousness of being a true prophet? Not many moons have filled since, in this department, we indulged in prophecy in the shape of the expressed hope that the European war would prove America capable of supplying the inevitable shortage in high-class medical literature. Of course, it would not have been either seemly or modest to have stated bluntly, and possibly blatantly, that we were going to measure up to the demand; and equally of course, it was much the more discreet policy to bide the time, cautiously waiting for the course of events to unfold themselves and for some disinterested agent to say for us that which we were anxious to say ourselves. Often there is much strategic advantage to be derived from allowing the unexpressed wish to be father of the thought. And such has turned out in this instance. The Italian journal *Policlinico*, in a recent issue, drew attention to the effect of the war on medical scientific productivity in Europe, and after noting the reduction both in the size and the material content of a large number of the old-world medical journals, went on to say, "The American medical journals scarcely seem aware of the terrible conflict going on in Europe. They are keeping alight the torch of medical science. They arrive unfailingly and serenely, although with occasional delays of two or three weeks; then they appear in a bunch." This is comforting and flattering as a type of international amenity, and we hope soon to hear similar strains in reference to American books, as well as journals. This much is certain — the American books of the month augur well for what is to follow, if we dare put our faith in augury. These books were conceived and executed "before the war." Who can tell how much better the product will be under the stimulus of *Policlinico's* flattering comment dangling before our eyes?

Over this first book[1] one may safely enthuse. It is a system of special surgery which through skillful editorial management has been given a homogeneity of form and a balance of value rarely met with in "systems." Every contributor seems to be striving to maintain a level of excellence that shall serve as a precedent for all future composite labor of similar sort. And this high level is mirrored largely in the independent character of the work. We miss under the various anatomical illustrations the usual insignia "From Spalteholz" or "From Toldt," and instead we have illustrations for the most part marvelously done, from original dissections, carefully carried out regarding details. The same statement holds true for the illustrations of operative technique; they are all original, clear-cut, and practically self-explanatory. So we feel that we may indulge in the luxury of enthusiasm.

There are in this first volume six chapters, devoted respectively to the surgical anatomy of the nose; surgical anatomy of the pharynx, larynx, and neck; surgical anatomy of the ear; external operations upon the larynx, pharynx, upper œsophagus, and trachea; laryngoscopy, tracheoscopy, bronchoscopy, œsophagoscopy, and gastroscopy; and plastic surgery of the nose and ear.

It has been our custom, in dealing with systems of surgery, to show by contrasts, selected from the volume under discussion, what constitutes the excellencies, and what the deficiencies. This volume disarms us from practicing our stock method, and forces the unqualified statement that we graciously accept the volume as it stands, and consider it, from the surgical point of view, as the best book of its type that we have on our own shelves. Possibly a broader acquaintance with this special field of surgical activity or a more intimate knowledge of rhino-oto-laryngological literature might prompt more specifically critical judgments; but then, after all, 'tis a pleasure once in a while to send forth praise unqualified.

THIS next American volume, done by Carroll W. Allen,[2] of New Orleans, and introduced to the world by the master Matas, makes its appearance just in time to be apropos our discussion regarding America's timeliness in putting her best foot forward. Up to the appearance of this volume, America has not put out, to my knowledge, a comprehensive book on local anæsthesia. This fact is rendered all the more striking when we consider the epochal work done along this line by Matas, Corning, Crile, Cushing, Hertzler, and numerous

[1] Operative Surgery of the Nose, Throat, and Ear. For Laryngologists, Rhinologists, Otologists, and Surgeons. By Hanau W. Loeb, M.D., in collaboration with Joseph C. Beck, M.D., R. B. Canfield, M.D., George W. Crile, M.D., Eugene A. Crockett, M.D., William H. Haskin, M.D., Robert Levy, M.D., Harris P. Mosher, M.D., George L. Richards, M.D., George E. Shambaugh, M.D., and George B. Wood, M.D. Vol. I. St. Louis: C. V. Mosby Company, 1914.

[2] Local and Regional Anæsthesia. By Carroll W. Allen, M.D. Philadelphia and London: W. B. Saunders Company, 1914.

other American surgeons. It has always been necessary to seek authentic information in Schleich's *Schmerzlose Operationen*, in Braun's *Local Anæsthesia*, or in one of the other two or three foreign standard works. Fortunately, the best of these foreign books have been translated, but more fortunately still, Allen's work appears now, presented in such form as to fill practically every desire that the most fastidious searcher for information in this line might express.

The book is bulky, practically an encyclopædia of local anæsthesia, done in six hundred well printed pages, and divided into twenty-three chapters, as follows: The history of local anæsthesia, the distribution of sensory nerves and the physiology and philosophy of pain, osmosis and diffusion, various local anæsthetics, toxicology, adrenalin, underlying technical principles, morphine, scopolamine, and combined drug anæsthesia, indications, contra-indications and shock, anoci-association, intra-arterial anæsthesia, the special application of local anæsthesia to the various regions of the body (seven chapters), spinal analgesia, epidural injections, and paravertebral and parasacral anæsthesia. Every one of these various chapters is complete and stands as a stimulating example of the one vital principle which ought to underlie all good book writing; namely, an urgent impulse to express thoughts, views, and methods that have been carefully worked out, thoroughly digested, distilled in the alembic of actual experience, found to be trustworthy, and believed to be essential truths of real value to all workers in the same field.

It is a pity that Allen accepts, root and branch, the doctrine of anoci-association, without at least a few words of critique. We would much rather have seen him qualify his statements after the fashion of Frazier in his recent article on "Hyperthyroidism." This could have been done without in any way detracting from the unlimited practical value of Crile's work, and if it had been done, would have strengthened our already strong faith in Allen's excellently critical and selective judgment.

Allen describes as possible, under local anæsthesia, operative precedures which many of us have experienced much difficulty in carrying out; but in local anæsthesia, as in literature, *le style est l'homme*, and it is undoubtedly true that one operator will accomplish much more satisfactory results than can his equally competent confrère, using seemingly exactly the same method.

THE Macmillan Company of New York made it just a trifle easier to prove that American medicine is measuring up to needs when they published the work of Dr. Bainbridge.[1] I do not know of another work in English that handles the cancer problem exactly as this book does. The excellent volume by W. Roger Williams approaches the same lines very closely (and one wonders, by the way, why Bainbridge does not include Williams' book in the very full bibliography appended to the end of his volume), but makes a much less emphatic appeal to the general reader. For that matter, even the classic German volumes by Borst, Wolff, Ribbert, and von Hansemann, although much more academic and authoritative, do not fill exactly the same niche that Bainbridge carved out for his special task — to produce "a book of ready reference, of convenient size, giving in succinct and available form a summary of knowledge concerning the subject (cancer)." The idea is to serve the general practitioner, specialist, intelligent layman, and all those who are interested in questions of health maintenance.

This purpose is worked out in fourteen excellently conceived and consecutively developed chapters, which furnish a clear, and what is more important, an interesting exposition of the ancient and modern history of cancer, its general distribution, statistical consideration, etiology, histopathology, a critical résumé of the results of cancer research, clinical considerations, prophylaxis, and so-called "cancer cures," non-surgical treatment, surgical treatment, inoperable growths, institutional care of cancer patients, the campaign of education, and a final chapter on "the outlook." And in all these chapters, be it said to Dr. Bainbridge's credit, there is no food for the morbid, in the guise of melodramatic illustrations or hair-raising word pictures.

With one exception, each subject head is treated in satisfactory fashion. The exception occurs in Chapter V, devoted to histopathology. Despite the overwhelming importance of the microscope in relation to cancer, Bainbridge seems to have willfully slurred the subject, and one feels that he did so in order not to dampen the interest of his "intelligent layman" reader. Then, too, there is a somewhat undesirable note of the impersonal in the book. Cancer surgery is, *par excellence*, militant surgery, and one seems to sense a false note in a book on cancer that is not also firm and true to scale in tone. It is, of course, a tremendously difficult task to collect, sift, rearrange, and present all the facts that Bainbridge had to pass in review, and he has accomplished his task so well, on the whole, that one feels loath to point out minor defects.

THE last two volumes of *Murphy's Clinics*[2] are better than any that have appeared during the year. The material is richer and more varied, and the editing is incomparably better than it has been in the past. It is a particularly unqualified pleasure to be able to say this, for, as we have so often repeated, much of the intrinsic value of the clinics has been marred by purely incidental, extrinsic, and wholly avoidable flaws.

The August *Clinic* is particularly good. The introductory talk on ileus is of the type that will bear rereading, and that drives home in excellently

[1] THE CANCER PROBLEM. By William Seaman Bainbridge, A.M., D., Sc.M.D. New York: The Macmillan Company, 1914.

[2] THE CLINICS OF JOHN B. MURPHY, M.D., AT MERCY HOSPITAL, CHICAGO. Volume III, Nos. 4 and 5, August, 1914, and October, 1914. Philadelphia and London: W. B. Saunders Company, 1914.

lucid fashion points of supreme practical as well as academic importance. Even those of us who have read this same chapter in the *Clinics* before may well feel that there is profit in the republication. Equally valuable is the clinic on Paget's cancer of the breast. Between every two lines of this description one notes an insistent desire to emphasize a vitally fundamental fact that, curiously enough, is driven into the consciousness of the majority of practitioners with extraordinary difficulty. The talks on facial nerve paralysis are full of interest, and the description of spinofacial nerve anastomosis particularly clear. In the clinic devoted to postoperative ventral hernia, Murphy recommends very early plastic repair of the hernia. It would be interesting to know if Dr. Murphy has fully considered the advantages of waiting until postoperative adhesions become delimited, before attempting herniotomy. Another point in the August volume that is rather startling develops in the clinic on cerebellar tumor. Dr. Murphy sets about to do a suboccipital decompression. He announces that the brain does not pulsate (the assumption is that intradural pressure is high) and yet he closes the scalp wound, without opening the dura, and refers to the procedure as a decompressive operation. Cushing specifically states that "the incision or removal of the dura (as well as the creation of a defect in the bone) is essential" in decompressive operations.

Arthroplasty of the hip, ascending root neuritis, malignant cyst of the breast, ununited Colles' fracture, intra-uterine fibroid, carcinoma of the rectum, sarcoma of the uterus, and luxation of the patella constitute the other subject heads of the August volume.

The October *Clinic* opens with a general diagnostic talk, followed by clinical lectures on traumatic epilepsy, epithelioma of the penis, fæcal fistula, old inversion fracture of the ankle, Pott's fracture, arthroplasty of the knee and elbow, hypertrophied prostate, imperforate anus, and the use of radium and X-rays in cancer. Most of these subjects Dr. Murphy has discussed before, but he has never so clearly presented the subject of inversion fracture of the ankle. Unfortunately, Dr. Murphy does not present his cases of tumor of the testicle in accordance with the modern and now generally accepted views enunciated by Chevassu, Most, and Ewing. If he accepted these newer views as correct, he would not be so "hard put" to explain the lymphatic dissemination of so-called sarcoma of the testicle.

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## BOOKS RECEIVED

Books received are acknowledged in this department, and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender. Selections will be made for review in the interests of our readers and as space permits.

WORRY AND NERVOUSNESS, OR THE SCIENCE OF SELF-MASTERY. By William S. Sadler, M.D. New York, Chicago, and San Francisco: A. C. McClurg & Company, 1914.

ABDOMINAL OPERATIONS. By Sir Berkeley Moynihan, M.S. (Lond.), F.R.C.S. Third edition, Volumes I and II. Philadelphia and London: W. B. Saunders Company, 1914.

A PRACTICAL MEDICAL DICTIONARY. By Thomas Lathrop Stedman, A.M., M.D., Third edition, revised. New York: William Wood & Company, 1914.

ANIMAL EXPERIMENTATION AND MEDICAL PROGRESS. By William Williams Keen, M.D., LL.D., with an introduction by Charles W. Eliot, LL.D. Boston and New York: Houghton Mifflin Company, 1914.

CASE HISTORIES IN OBSTETRICS. Groups of Cases Illustrating the Fundamental Problems which Arise in Obstetrics. By Robert L. De Normandie, A.B., M.D. Boston: W. M. Leonard, 1914.

A SYSTEM OF OPERATIVE SURGERY. Edited by F. F. Burghard, M.S. (Lond.), F.R.C.S. (Eng.). Second edition, five volumes. London and New York: Oxford University Press, 1914.

PRÉCIS DE CHIRURGIE DE GUERRE. By Edmond Delorme. Paris: Masson et Cie, 1914.

SELECTED PAPERS, Surgical and Scientific, from the Writings of Roswell Park. Buffalo: Julian Park, 1914.